

ENGINE MECHANICAL

SECTION **EM**

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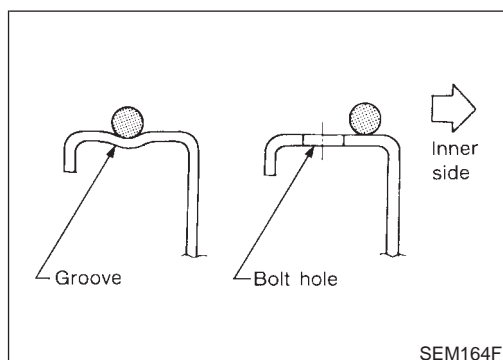
PRECAUTIONS

Parts Requiring Angular Tightening

Parts Requiring Angular Tightening

NFEM0001

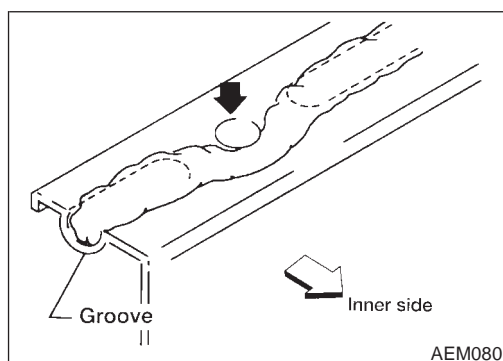
- Use an angle wrench for the final tightening of the following engine parts:
 - a) Cylinder head bolts
 - b) Main bearing cap bolts
 - c) Connecting rod cap nuts
 - d) Crankshaft pulley bolt
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.



Liquid Gasket Application Procedure

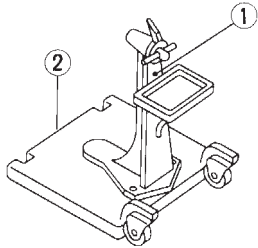
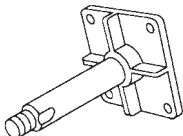
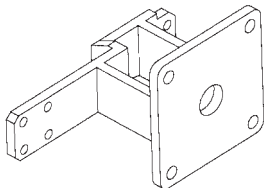
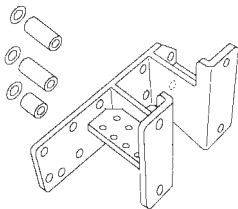
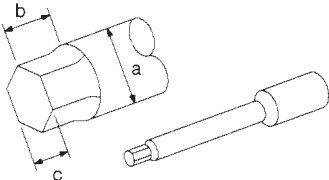
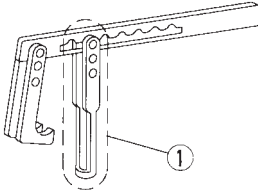
NFEM0002

1. Use a scraper to remove all traces of old liquid gasket from mating surfaces and grooves. Also, completely clean any oil from these areas.
2. Apply a continuous bead of liquid gasket to mating surfaces. (Use Genuine Liquid Gasket or equivalent.)
 - Be sure liquid gasket diameter is as specified.
3. Apply liquid gasket around the inner side of bolt holes (unless otherwise specified).
4. Assembly should be done within 5 minutes after coating.
5. Wait at least 30 minutes before refilling engine oil and engine coolant.



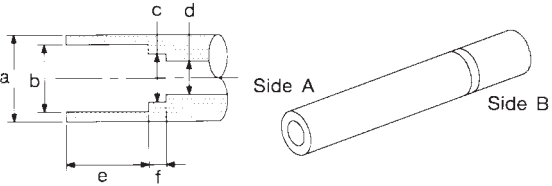
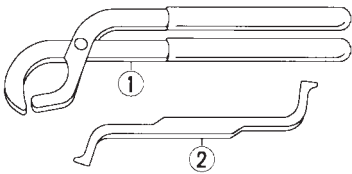
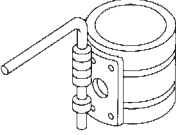
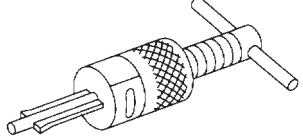
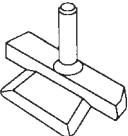
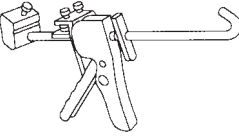
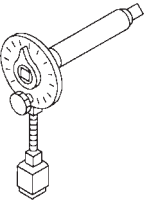
PREPARATION

Special Service Tools

Special Service Tools			NFEM0003
Tool number Tool name	Description		
ST0501S000 Engine stand assembly 1 ST05011000 Engine stand 2 ST05012000 Base	 <p>NT042</p>	Disassembling and assembling	
KV10106500 Engine stand shaft	 <p>NT028</p>		
KV10117000 Engine sub-attachment	 <p>NT373</p>	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).	
KV10117001 Engine sub-attachment	 <p>NT372</p>	Installing on the cylinder block	
ST10120000 Cylinder head bolt wrench	 <p>NT583</p>	Loosening and tightening cylinder head bolt a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)	
KV10116200 Valve spring compressor 1 KV10115900 Attachment	 <p>NT022</p>	Disassembling valve mechanism	

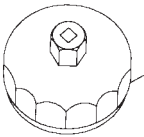
PREPARATION

Special Service Tools (Cont'd)

Tool number Tool name	Description
KV10115600 Valve oil seal drift	 <p>NT603</p> <p>Installing valve oil seal Use side A. Side A a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. d: 8 (0.31) dia. e: 10.7 (0.421) f: 5 (0.20) Unit: mm (in)</p>
KV101151S0 Lifter stopper set 1 KV10115110 Camshaft pliers 2 KV10115120 Lifter stopper	 <p>NT041</p> <p>Changing shims</p>
EM03470000 Piston ring compressor	 <p>NT044</p> <p>Installing piston assembly into cylinder bore</p>
ST16610001 Pilot bushing puller	 <p>NT045</p> <p>Removing crankshaft pilot bushing</p>
KV10111100 Seal cutter	 <p>NT046</p> <p>Removing steel oil pan and rear timing chain case</p>
WS39930000 Tube presser	 <p>NT052</p> <p>Pressing the tube of liquid gasket</p>
KV10112100 Angle wrench	 <p>NT014</p> <p>Tightening bolts for bearing cap, cylinder head, etc.</p>


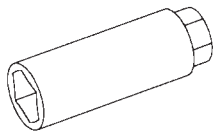
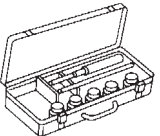
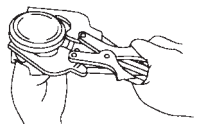
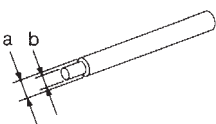
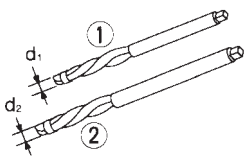
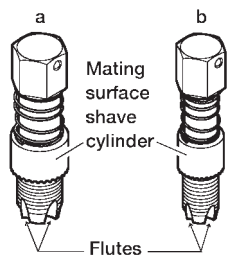
PREPARATION

Special Service Tools (Cont'd)

Tool number Tool name	Description
KV10115800 KV10115801 (Kent-Moore Europe make) Oil filter wrench	<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>14 faces, Inner span: 64.3 mm (2.531 in) (Face to opposite face)</p> </div> </div> <p style="text-align: right;">Removing oil filter</p> <p>NT362</p>

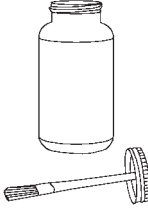
Commercial Service Tools

NFEM0004

Tool number Tool name	Description
Spark plug wrench	<div style="display: flex; align-items: center;">   </div> <p style="text-align: right;">Removing and installing spark plug</p> <p>NT047</p>
Valve seat cutter set	 <p style="text-align: right;">Finishing valve seat dimensions</p> <p>NT048</p>
Piston ring expander	 <p style="text-align: right;">Removing and installing piston ring</p> <p>NT030</p>
Valve guide drift	 <p style="text-align: right;"> Removing and installing valve guide Intake & Exhaust: a = 9.5 mm (0.374 in) dia. b = 5.5 mm (0.217 in) dia. </p> <p>NT015</p>
Valve guide reamer	 <p style="text-align: right;"> Reaming valve guide 1 or hole for oversize valve guide 2 Intake & Exhaust: d₁ = 6.0 mm (0.236 in) dia. d₂ = 10.2 mm (0.402 in) dia. </p> <p>NT016</p>
Oxygen sensor thread cleaner	<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>Mating surface shave cylinder</p> <p>Flutes</p> </div> </div> <p style="text-align: right;"> Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) a = [18 mm dia. and pitch of 1.5 mm] for zirconia oxygen sensor b = [12 mm dia. and pitch of 1.25 mm] for titania oxygen sensor </p> <p>AEM488</p>

PREPARATION

Commercial Service Tools (Cont'd)

Tool number Tool name	Description
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A- 907)	<div></div> <div>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</div> <div>AEM489</div>

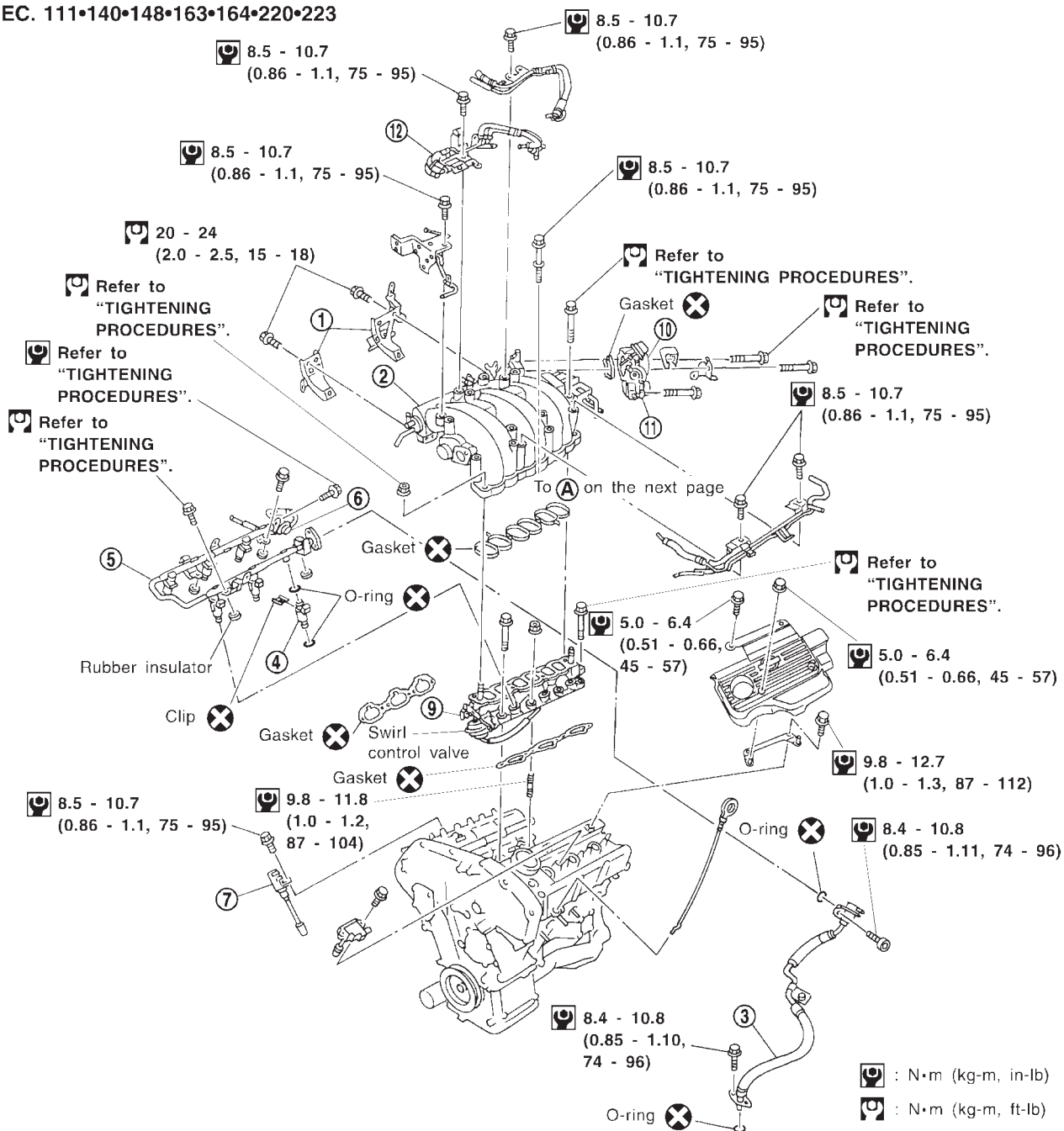
OUTER COMPONENT PARTS

Removal and Installation

Removal and Installation

NFEM0006

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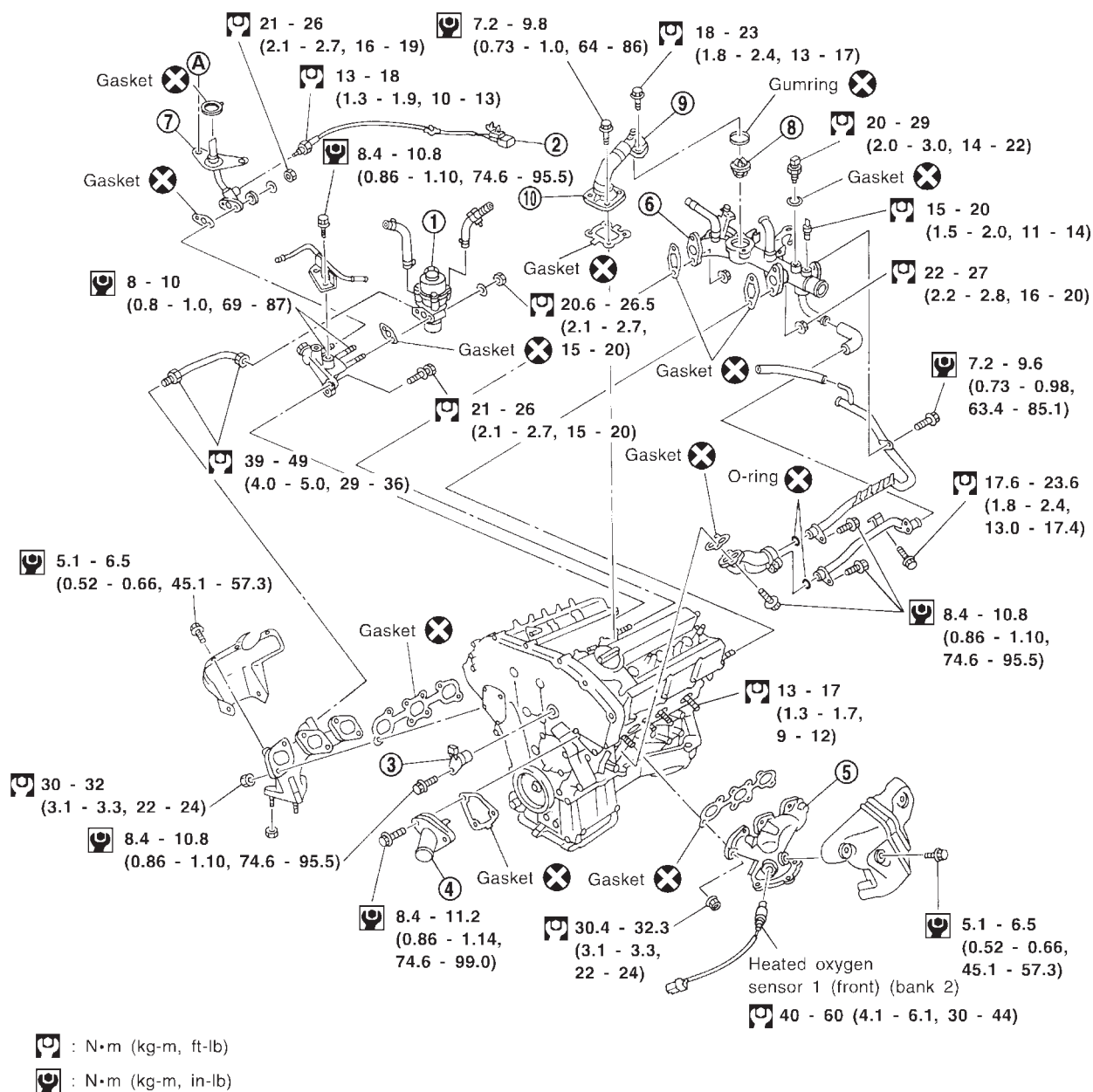
SEM524G

- | | | |
|--|--|---|
| 1. Intake manifold collector support | 5. Fuel tube assembly | 9. Intake manifold |
| 2. Intake manifold collector | 6. Fuel pressure regulator | 10. Throttle body |
| 3. Fuel damper and fuel feed hose assembly | 7. Ignition coil with power transistor | 11. IACV-AAC valve |
| 4. Injector | 8. Ornament engine cover | 12. EVAP canister purge volume control solenoid valve |

OUTER COMPONENT PARTS

Removal and Installation (Cont'd)

SEC. 140•147•210•211•221

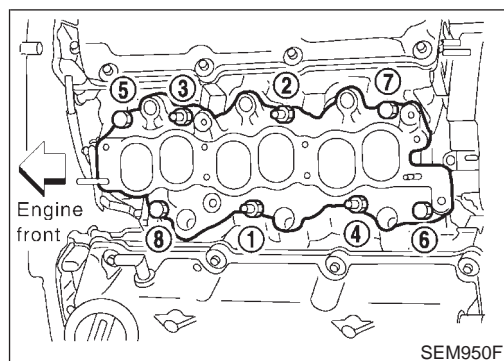


SEM525G

- | | | |
|-------------------------------------|--------------------------------|---------------------------------|
| 1. EGR valve | 4. Thermostat with water inlet | 8. Water control valve |
| 2. EGR temperature sensor | 5. Exhaust manifold | 9. Water connector |
| 3. Camshaft position sensor (PHASE) | 6. Water outlet | 10. Cylinder block water outlet |
| | 7. EGR guide tube | |

OUTER COMPONENT PARTS

Removal and Installation (Cont'd)



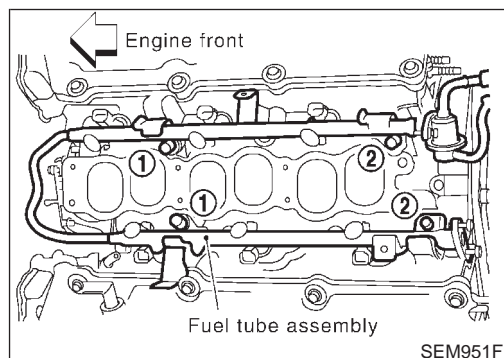
TIGHTENING PROCEDURES

Intake Manifold

NFEM0006S01

NFEM0006S0101

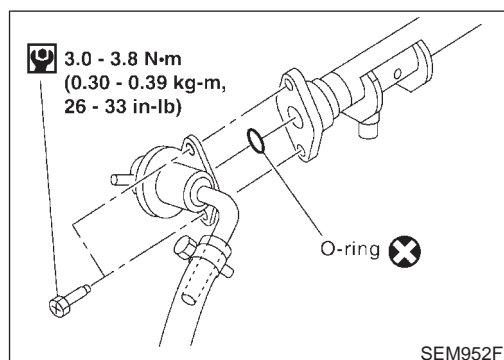
- Tighten in numerical order shown in the figure.
1. Tighten all bolts and nuts to 5 to 10 N·m (0.5 to 1.0 kg-m, 44 to 86 in-lb).
 2. Finally tighten all bolts and nuts to 26 to 31 N·m (2.7 to 3.2 kg-m, 20 to 23 ft-lb).
- Tighten all bolts and nuts to the final torque, evenly dividing the tightening into at least five steps.



Fuel Tube

NFEM0006S0102

- Tighten in numerical order shown in the figure.
1. Tighten all bolts to 9.3 to 10.8 N·m (0.95 to 1.1 kg-m, 83 to 95 in-lb).
 2. Then tighten all bolts to 21 to 26 N·m (2.1 to 2.7 kg-m, 15 to 20 ft-lb).

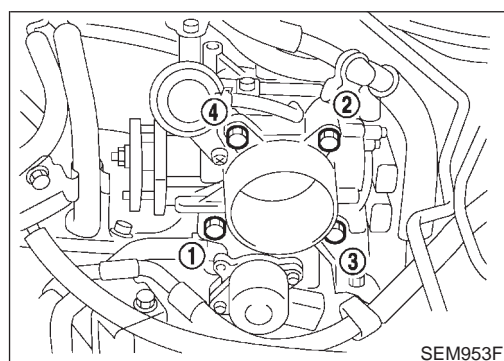


Fuel Pressure Regulator

NFEM0006S0103

Tighten fuel pressure regulator to 2.9 to 3.8 N·m (0.3 to 0.39 kg-m, 26.0 to 33.9 in-lb).

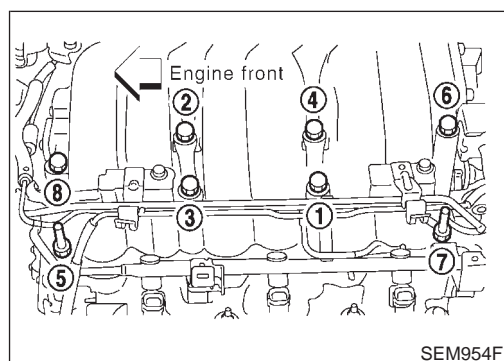
- Tighten screws evenly several times to have the fuel pressure regulator tightened at the specified torque.
- Always replace O-ring with new ones.
- Lubricate O-ring with new engine oil.



Throttle Body

NFEM0006S0105

- Tighten in numerical order shown in the figure.
1. Tighten all bolts to 8.8 to 10.8 N·m (0.9 to 1.1 kg-m, 79 to 95 in-lb).
 2. Then tighten all bolts to 17.7 to 21.6 N·m (1.8 to 2.2 kg-m, 13 to 16 ft-lb).

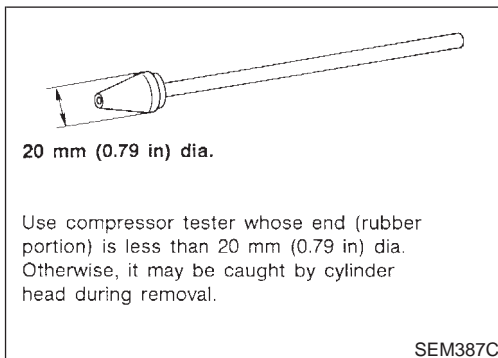
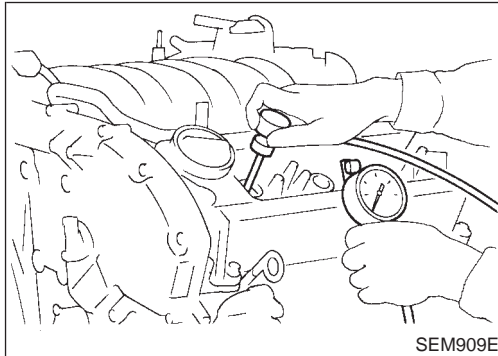
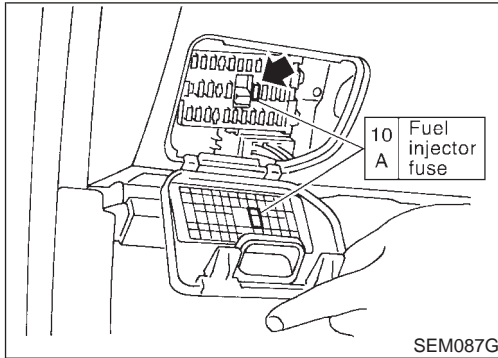


Intake Manifold Collector

NFEM0006S0107

Tighten bolts and nuts to 11 to 15 N·m (1.1 to 1.6 kg-m, 8 to 11 ft-lb) in numerical order shown in the figure.

MEASUREMENT OF COMPRESSION PRESSURE



1. Warm up engine.
2. Turn ignition switch OFF.
3. Release fuel pressure.
Refer to EC-36, "Fuel Pressure Release".
4. Disconnect ignition coil with power transistor harness connectors, then remove ignition coils.
5. Remove all spark plugs.
6. Remove fuel injector fuse.
7. Attach a compression tester to No. 1 cylinder.
8. Depress accelerator pedal fully to keep throttle valve wide open.
9. Crank engine and record highest gauge indication.
10. Repeat the measurement on each cylinder as shown above.
- **Always use a fully-charged battery to obtain specified engine speed.**

Unit: kPa (bar, kg/cm², psi)/rpm

Engine	Standard	Minimum	Difference limit between cylinders
VQ20DE VQ30DE	1,275 (12.75, 13.0, 185)/300	981 (9.81, 10.0, 142)/300	98 (0.98, 1.0, 14)/300

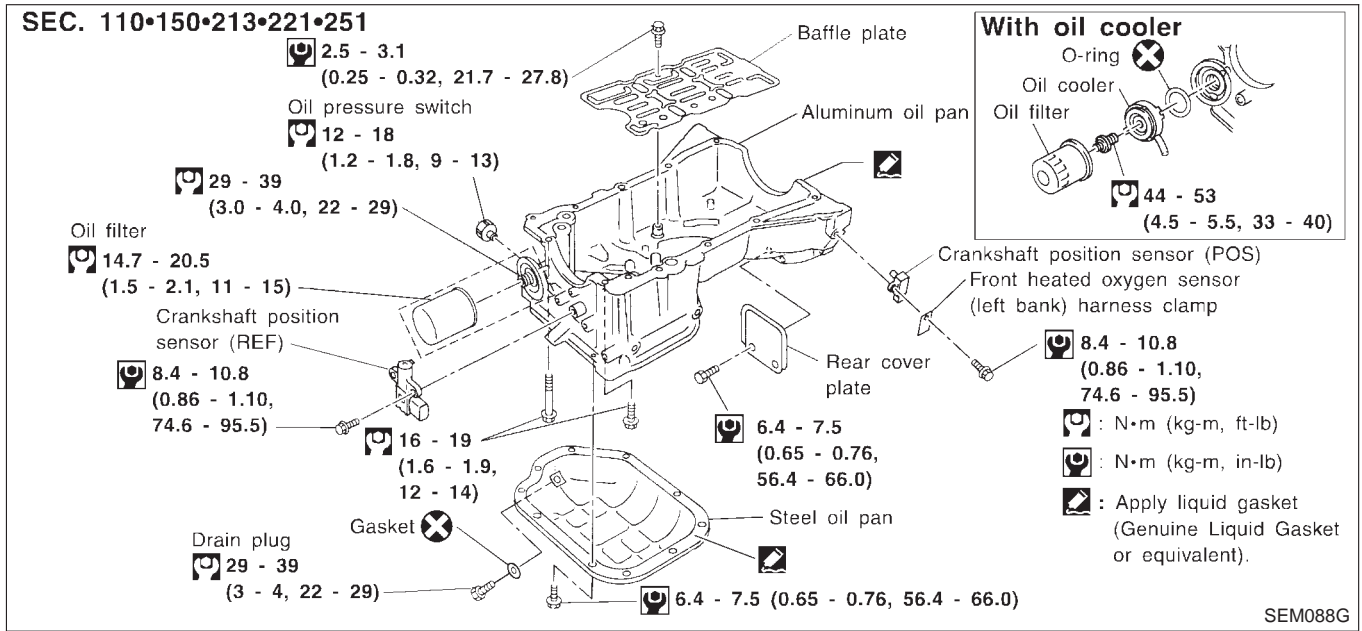
11. If compression in one or more cylinders is low:
 - a. Pour a small amount of engine oil into cylinders through spark plug holes.
 - b. Retest compression.
- **If adding oil helps compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
- **If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. (Refer to SDS, EM-73 and EM-78.) If valve or valve seat is damaged excessively, replace them.**
- **If compression stays low in two cylinders that are next to each other:**
 - a) The cylinder head gasket may be leaking, or
 - b) Both cylinders may have valve component damage. Inspect and repair as necessary.

OIL PAN

Components

Components

NFEM0008



Removal

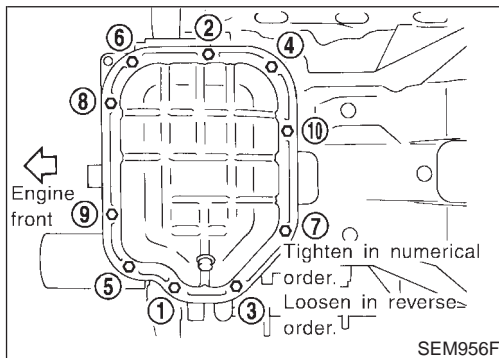
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CAUTION:

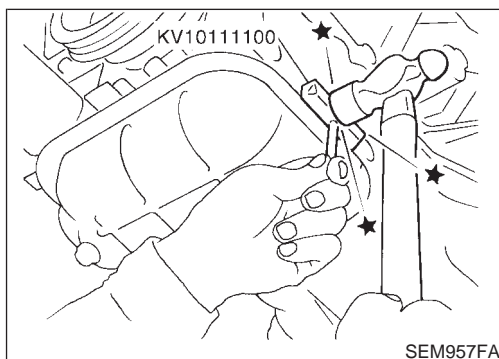
When removing the aluminum oil pan from engine, first remove the crankshaft position sensors (POS and REF) from the assembly.

Be careful not to damage sensor edges and signal plate teeth.

1. Remove engine undercover.
2. Drain engine oil.



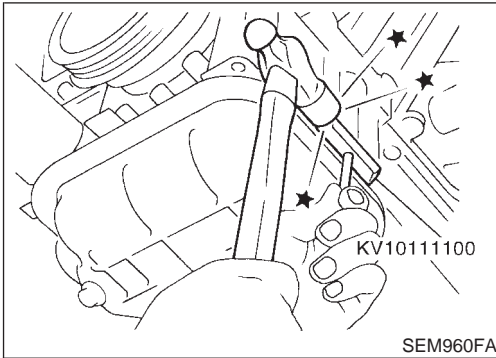
3. Remove steel oil pan bolts.



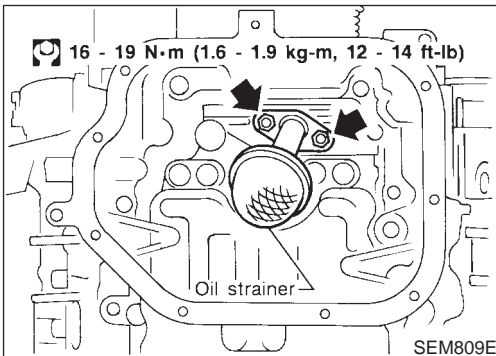
4. Remove steel oil pan.
 - a. Insert Tool between aluminum oil pan and steel oil pan.
 - Be careful not to damage aluminum mating surface.
 - Do not insert screwdriver, or oil pan flange will be deformed.

OIL PAN

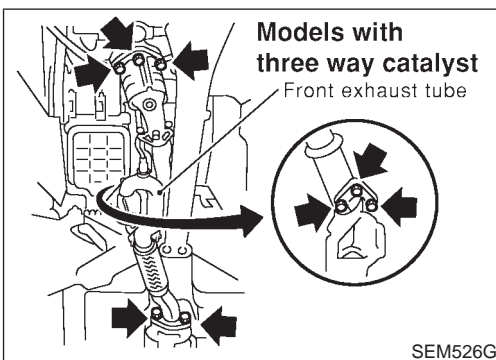
Removal (Cont'd)



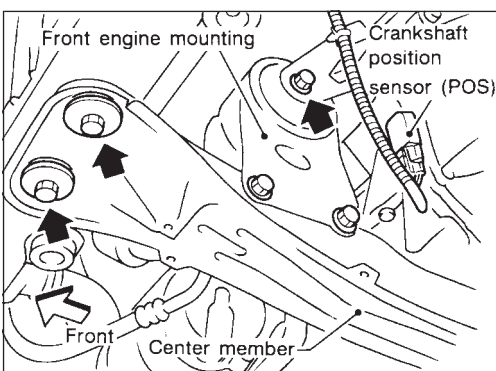
- b. Slide Tool by tapping on the side of the Tool with a hammer.
- c. Remove steel oil pan.



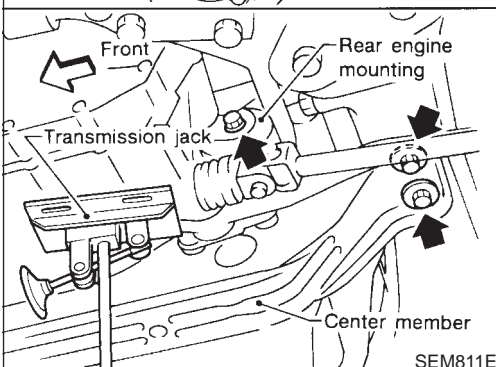
5. Remove oil strainer.



6. Remove front exhaust tube and its support.
Refer to FE-10, "Removal and Installation".

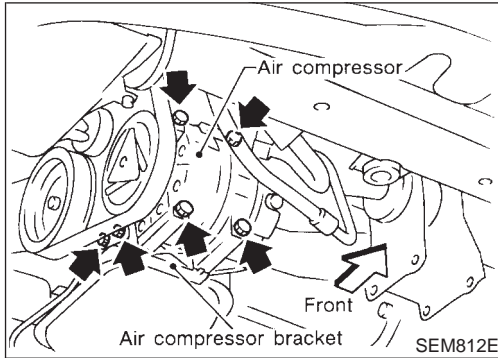


7. Set a suitable transmission jack under transaxle and hoist engine with engine slinger.
8. Remove crankshaft position sensors (POS and REF) from oil pan.
9. Remove front and rear engine mounting nuts and bolts.
10. Remove center member.

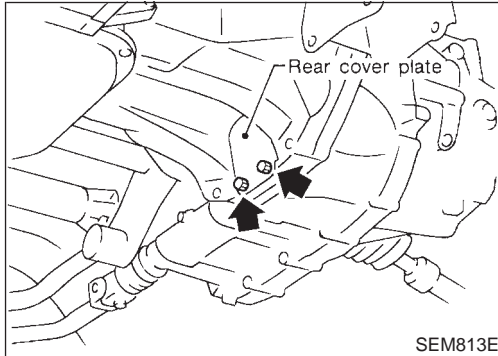


OIL PAN

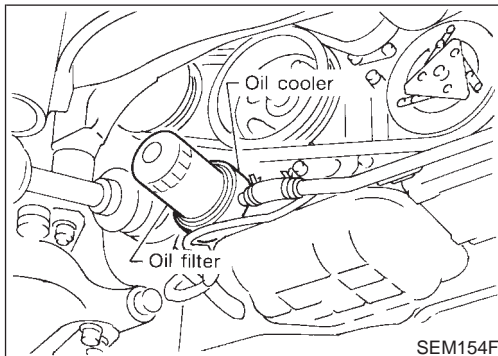
Removal (Cont'd)



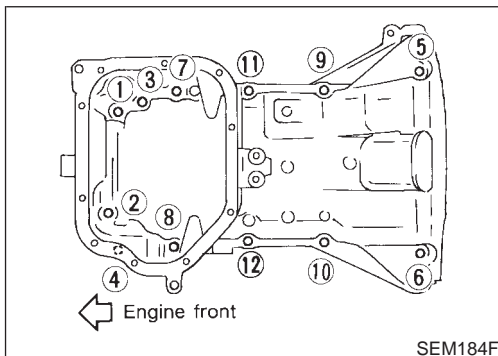
11. Remove drive belts.
12. Remove air compressor and bracket.



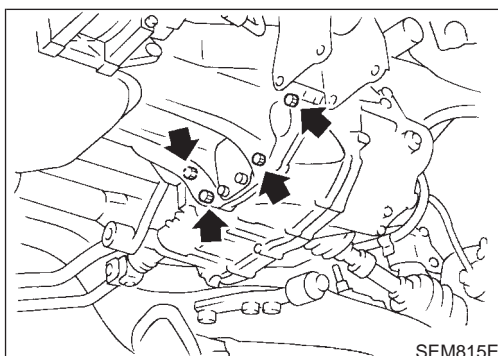
13. Remove rear cover plate.



14. Remove oil filter, oil cooler fixing bolt and water hoses or pipes (For models with oil cooler).



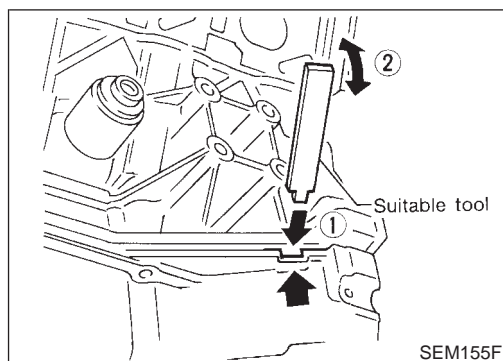
15. Remove aluminum oil pan bolts in numerical order.



16. Remove four engine-to-transaxle bolts.

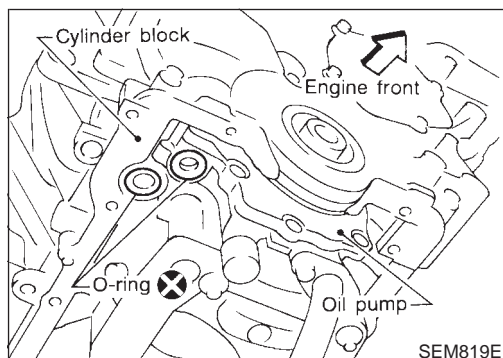
OIL PAN

Removal (Cont'd)

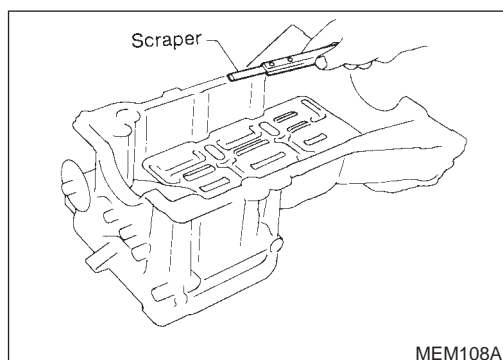


17. Remove aluminum oil pan.

- Insert an appropriate size tool into the notch of aluminum oil pan as shown in the figure.
 - Be careful not to damage aluminum mating surface.**
 - Do not insert screwdriver, or oil pan flange will be deformed.**
- Pry off aluminum oil pan by moving the tool up and down.
- Remove aluminum oil pan.



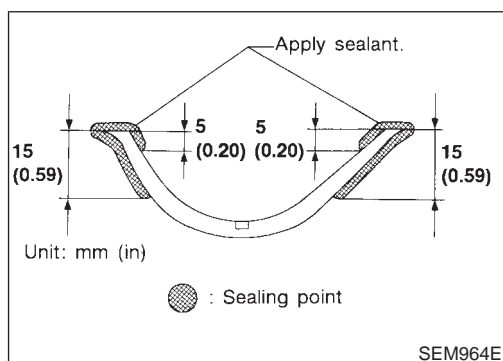
18. Remove O-rings from cylinder block and oil pump body.



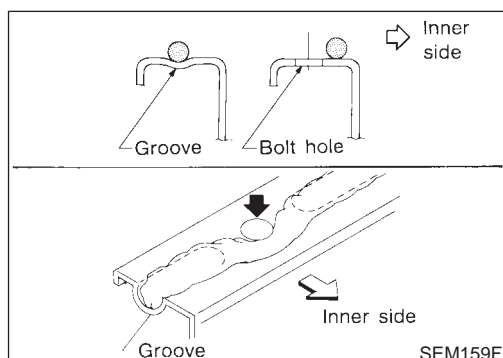
Installation

NFEM0010

- Install aluminum oil pan.
 - Use a scraper to remove old liquid gasket from mating surfaces.
 - Also remove old liquid gasket from mating surface of cylinder block, front cover and steel oil pan.**
 - Remove old liquid gasket from the bolt hole and thread.**



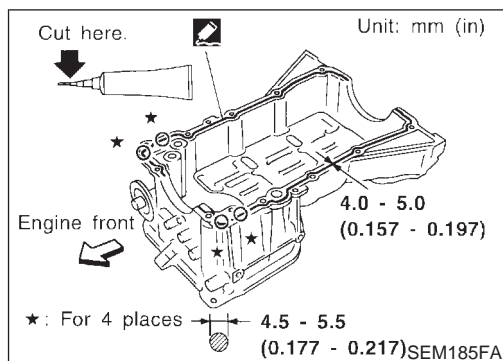
- Apply sealant to front cover gasket and rear oil seal retainer gasket.



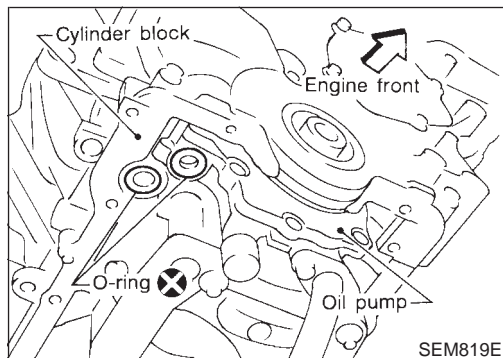
- Apply a continuous bead of liquid gasket to mating surface of aluminum oil pan.
 - Use Genuine Liquid Gasket or equivalent.**

OIL PAN

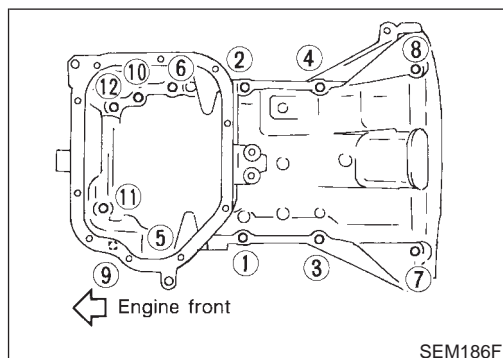
Installation (Cont'd)



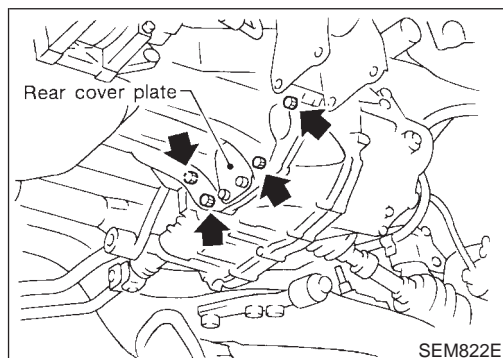
- d. Apply liquid gasket to inner sealing surface as shown in figure.
 - Be sure liquid gasket is 4.0 to 5.0 mm (0.157 to 0.197 in) or 4.5 to 5.5 mm (0.177 to 0.217 in) wide.
 - Attaching should be done within 5 minutes after coating.



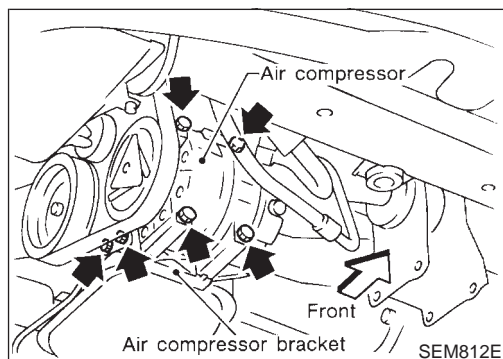
- e. Install O-rings, cylinder block and oil pump body.



- f. Install aluminum oil pan.
 - Tighten bolts in numerical order.
 - **Wait at least 30 minutes before refilling engine oil.**
- g. Install oil cooler, water hoses and pipes (For models with oil cooler).



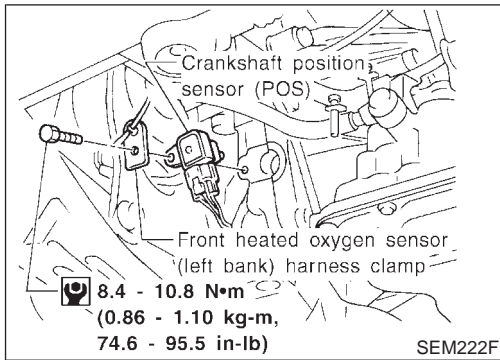
2. Install the four engine-to-transaxle bolts. For tightening torque, refer to MT-10 or AT-352, "Installation".
3. Install rear cover plate. For tightening torque of the oil cooler fixing bolt, refer to LC-7, "Oil Cooler".



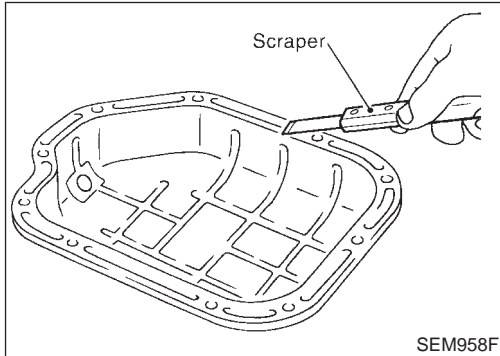
4. Install air compressor and bracket. Refer to HA-208, "Removal and Installation".
5. Install drive belts.
6. Install center member.
7. Install front and rear engine mounting insulator nuts and bolts.

OIL PAN

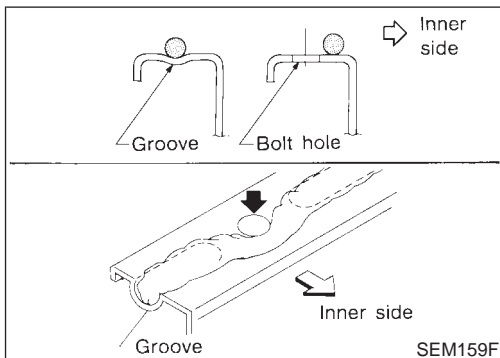
Installation (Cont'd)



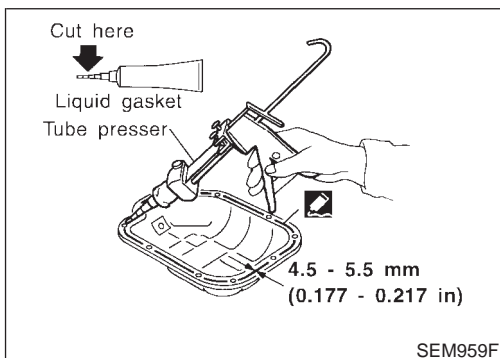
8. Install crankshaft position sensors (POS and REF) and front heated oxygen sensor (left bank) harness clamp.
 - **Make sure that crankshaft position sensor (POS) and front heated oxygen sensor (left bank) harness clamp are installed correctly as shown in figure.**
9. Install front exhaust tube and its support.
10. Install oil strainer.



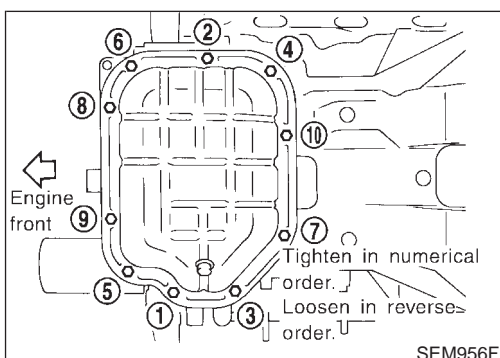
11. Install steel oil pan.
 - a. Use a scraper to remove old liquid gasket from mating surfaces.
 - **Also remove old liquid gasket from mating surface of aluminum oil pan.**



- b. Apply a continuous bead of liquid gasket to mating surface of steel oil pan.
 - **Use Genuine Liquid Gasket or equivalent.**



- **Be sure liquid gasket is 4.5 to 5.5 mm (0.177 to 0.217 in) wide.**
- **Attaching should be done within 5 minutes after coating.**




- c. Install steel oil pan.
 - **Tighten in numerical order shown in the figure.**
 - **Wait at least 30 minutes before refilling engine oil.**


Components


NEFM0011


 Refer to "Installation" in "CYLINDER HEAD".


 119 - 128
(12.1 - 13.1, 88 - 95)



 8.4 - 10.8
(0.86 - 1.10, 74.6 - 95.5)



 8.4 - 10.8
(0.86 - 1.10, 74.6 - 95.5)


 13 - 19
(1.3 - 1.9, 9 - 14)


Water drain plug 


 7.8 - 12
(0.8 - 1.2, 69 - 104)



  119 - 128
(12.1 - 13.1,
88 - 95)

Plug 
 9.8 - 14.7
 (1.00 - 1.50, 86.8 - 130.2)


 Refer to "Water Pump" in LC section.


 13 - 19
(1.3 - 1.9,
9 - 14)

 8.4 - 10.8
(0.86 - 1.10, 74.6 - 95.5)

  119 - 128
(12.1 - 13.1,
88 - 95)

 Refer to "Installation" in "TIMING CHAIN".

 10 - 13 (1.0 - 1.3, 87 - 113)


 : Apply liquid gasket
(Genuine Liquid Gasket
or equivalent).


 : Lubricate with new engine oil.



 : N·m (kg-m, ft-lb)

 : N•m (kg-m, in-lb)

 Refer to “Installation”
in “TIMING CHAIN”.

Gasket 

oil seal 

  Refer to "Installation"
in "OIL PAN".

 Refer to "Installation" in "TIMING CHAIN".

SEM094G

- | | | |
|-----------------------------------|-----------------------------|-----------------------------------|
| 1. Rear timing chain case | 8. Timing chain | 14. Water pump cover |
| 2. Left camshaft chain tensioner | 9. Crankshaft sprocket | 15. Chain tensioner cover |
| 3. Internal chain guide | 10. Lower chain guide | 16. Exhaust camshaft sprocket 2ND |
| 4. Camshaft chain | 11. Upper chain guide | 17. Intake camshaft sprocket 2ND |
| 5. Right camshaft chain tensioner | 12. Front timing chain case | 18. Camshaft sprocket 1ST |
| 6. Timing chain tensioner | 13. Crankshaft pulley | 19. Water pump |
| 7. Slack side chain guide | | |

POSITION FOR APPLYING LIQUID GASKET

=NFEM0011S01

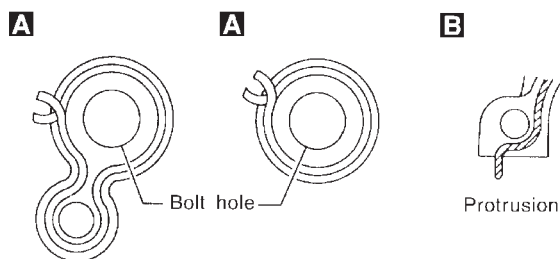
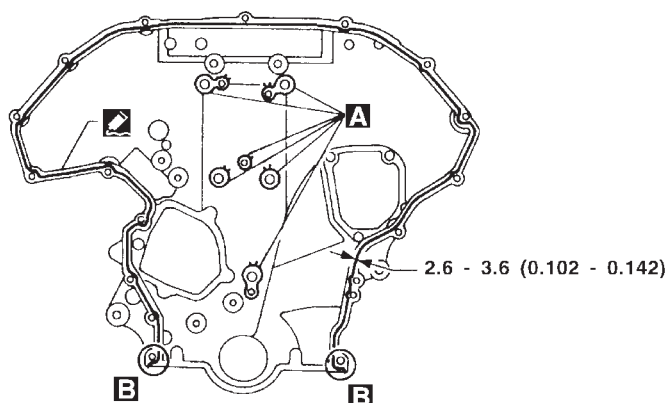
Refer to "Installation" in "OIL PAN", EM-15.

- Before installation, wipe off the protruding sealant.

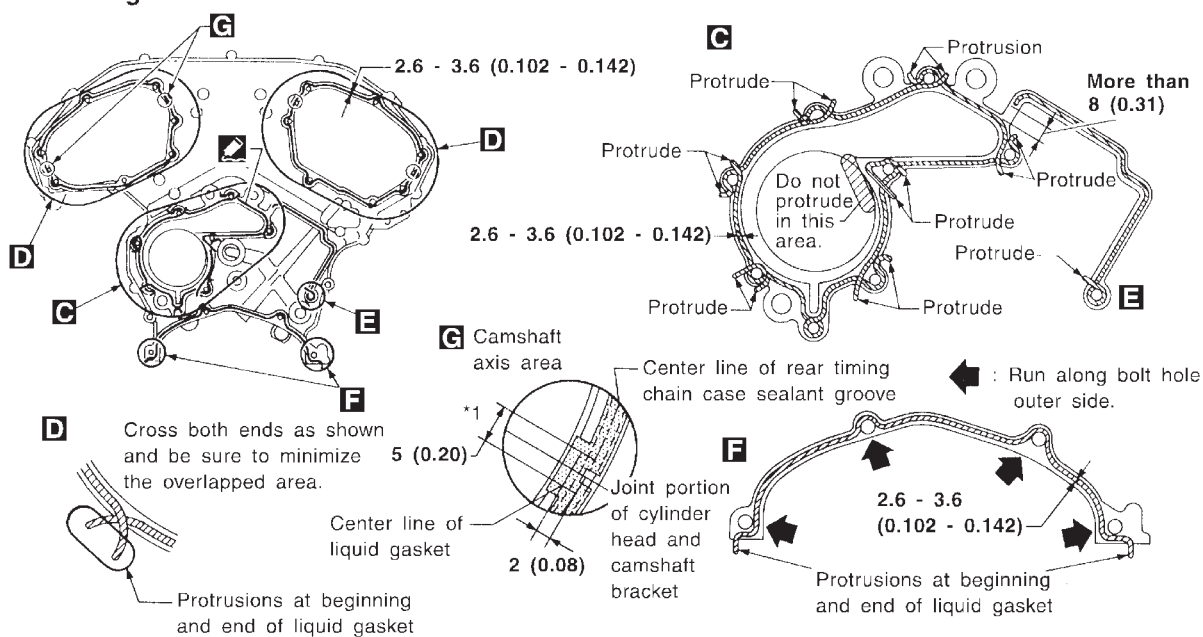
TIMING CHAIN

Components (Cont'd)

Front timing chain case

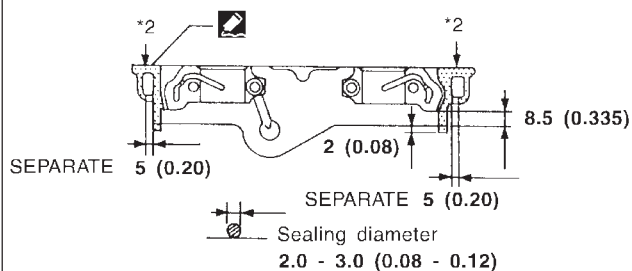


Rear timing chain case



*1 : Apply liquid gasket to the chamfered surface between camshaft bracket and cylinder head.

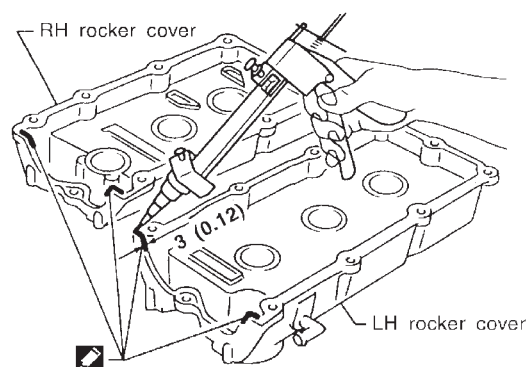
Camshaft bracket



*2 : Remove the protruding sealant from front face.
(Remove the hardened sealant from surface only.)

Unit: mm (in)

Rocker cover



SEM443FA

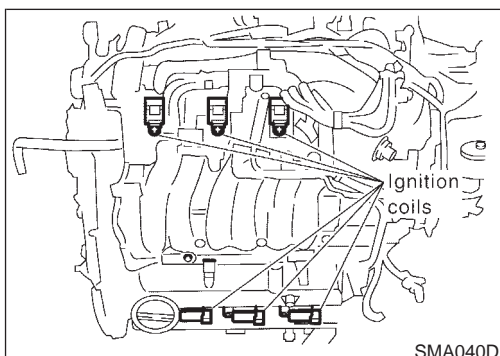
CAUTION:

- After removing timing chain, do not turn crankshaft and camshaft separately, or valves will strike piston heads.
- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to bolt threads and seat surfaces when installing cylinder head, camshaft sprockets, crankshaft pulley, and camshaft brackets.
- Before disconnecting fuel hose, release fuel pressure. Refer to EC-36, "Fuel Pressure Release".
- When removing the oil pans, oil pump assembly and timing chain from engine, first remove the camshaft position sensor (PHASE) and the crankshaft position sensors (REF)/(POS) from the assembly. Be careful not to damage sensor edges.
- Do not spill engine coolant on drive belts.

Removal

NFEM0012

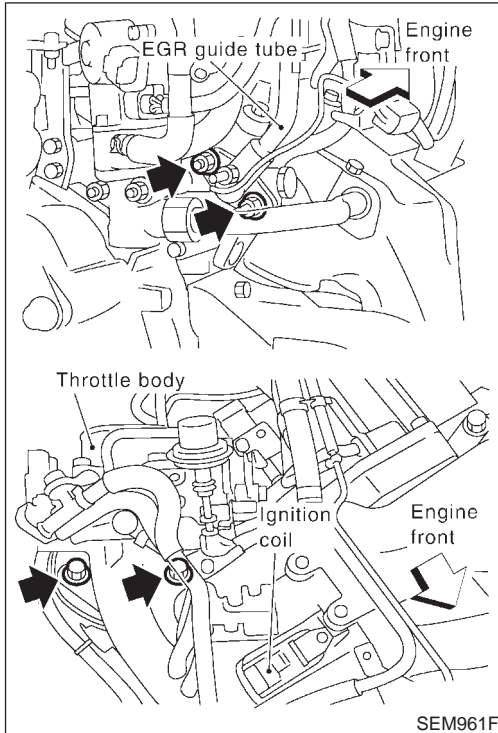
1. Drain engine oil.
2. Release fuel pressure.
Refer to EC-36, "Fuel Pressure Release".
3. Drain coolant by removing cylinder block drain plugs. Refer to MA-16, "Changing Engine Coolant".
4. Remove left side ornament cover.
5. Remove air duct to intake manifold, collector, blow-by hose, vacuum hoses, fuel hoses, wires, harness, connectors and so on.
6. Remove the following.
 - Vacuum hoses
 - Water hoses
 - EVAP canister purge hose
 - Blow-by hose



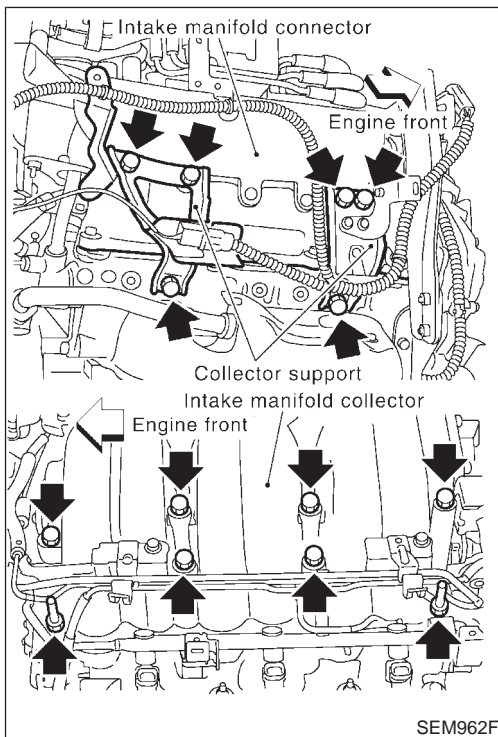
7. Remove RH and LH ignition coils.

TIMING CHAIN

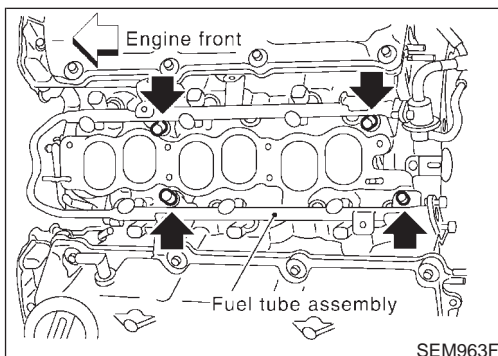
Removal (Cont'd)



8. Remove EGR guide tube.



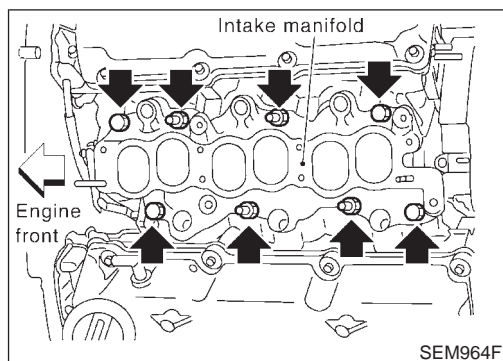
9. Remove intake manifold collector supports and intake manifold collector (RH cylinder head only).



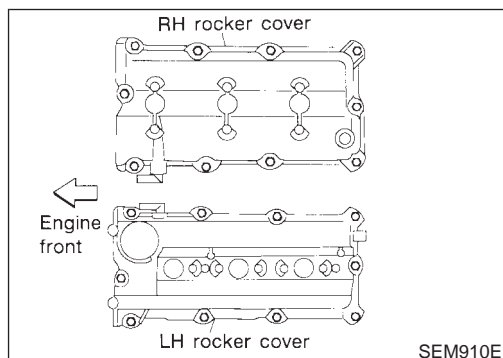
10. Remove fuel tube assembly. Refer to EC-38, "Injector Removal and Installation".

TIMING CHAIN

Removal (Cont'd)



11. Remove intake manifold in reverse order of installation. Refer to "TIGHTENING PROCEDURES", EM-10.

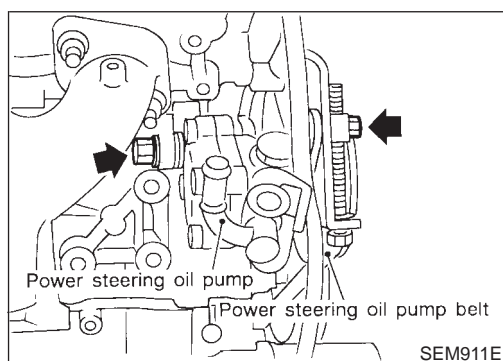


12. Remove RH and LH rocker covers from cylinder head.

13. Remove engine undercover.

14. Remove front RH wheel and engine side cover.

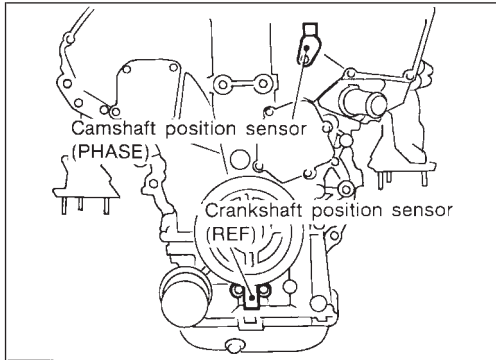
15. Remove drive belts and idler pulley bracket.



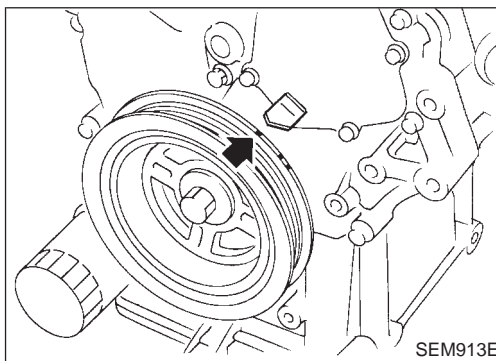
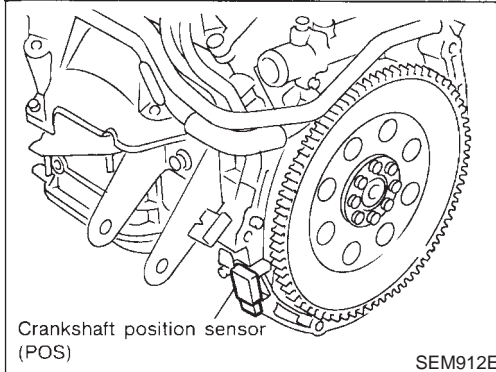
16. Remove power steering oil pump belt and power steering oil pump assembly.

TIMING CHAIN

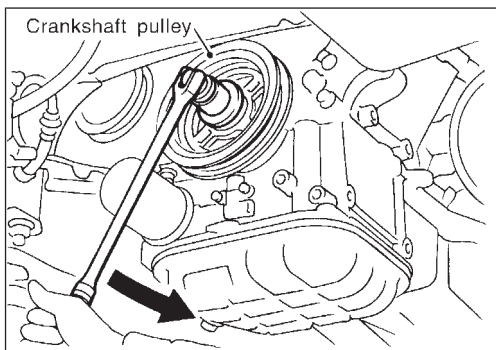
Removal (Cont'd)



17. Remove camshaft position sensor (PHASE) and crankshaft position sensors (REF)/(POS).

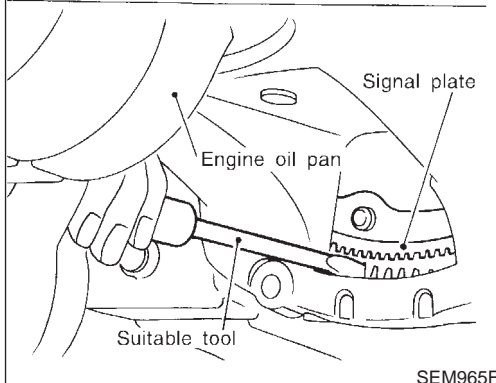


18. Set No. 1 piston at TDC on the compression stroke by rotating crankshaft.



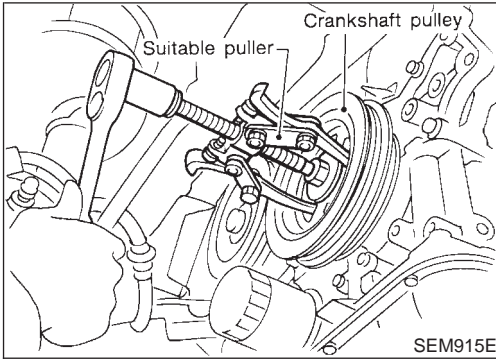
19. Loosen crankshaft pulley bolt. (At this time remove oil pan rear cover plate and set a suitable tool to ring gear so that crankshaft cannot rotate.)

- Be careful not to damage the signal plate teeth.

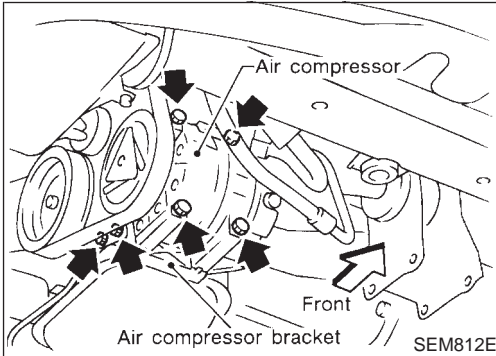


TIMING CHAIN

Removal (Cont'd)



20. Remove crankshaft pulley with a suitable puller.



21. Remove air compressor and bracket.

22. Remove front exhaust tube and its support.

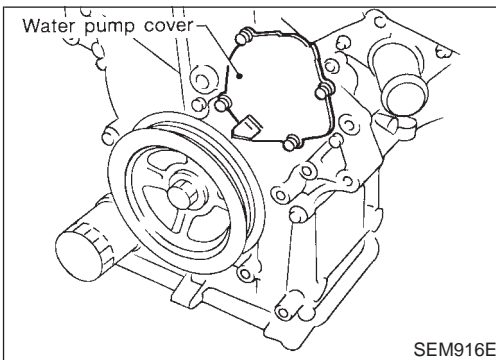
23. Hang engine at right and left side engine slingers with a suitable hoist.

24. Remove right side engine mounting, mounting bracket and nuts.

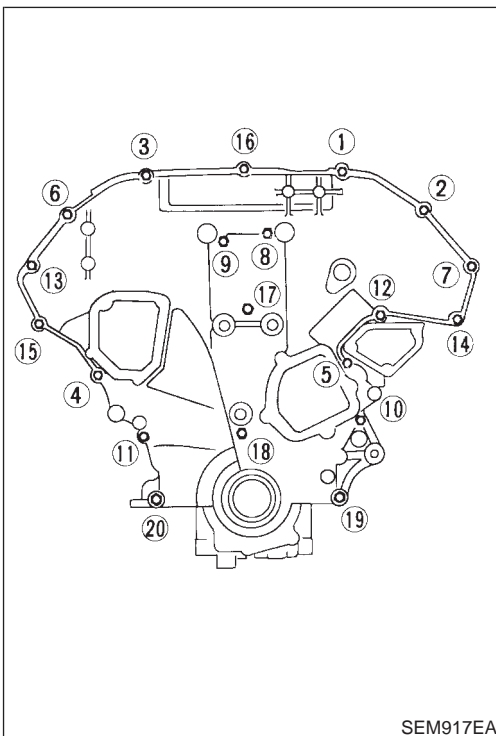
25. Remove center member assembly.

26. Remove upper and lower oil pans.

- For procedures described in steps 21 through 26, refer to "Removal", EM-12.



27. Remove water pump cover.

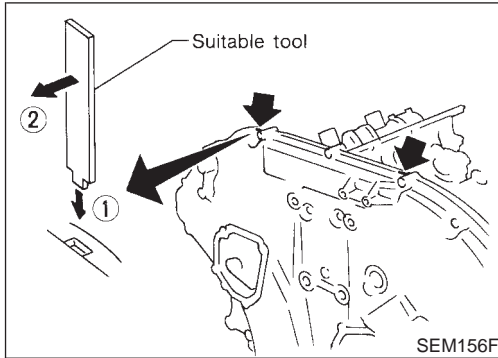


28. Remove front timing chain case bolts.

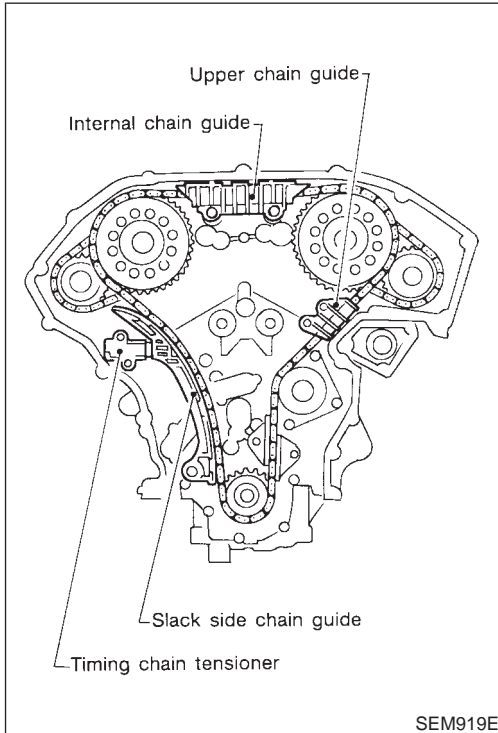
- Loosen bolts in numerical order as shown in the figure.

TIMING CHAIN

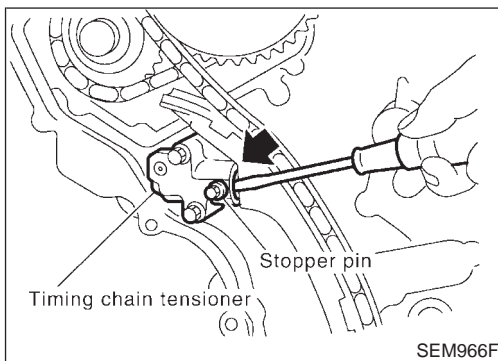
Removal (Cont'd)



29. Remove front timing chain case.
- Do not scratch sealing surfaces.



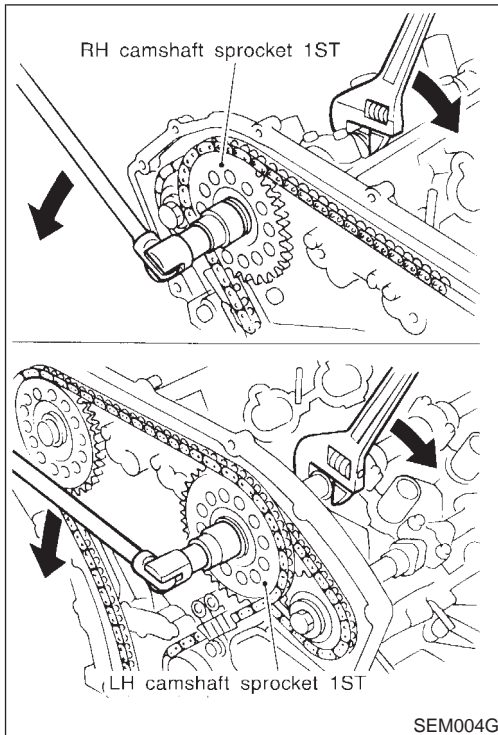
30. Remove internal chain guide.
31. Remove upper chain guide.
32. Remove timing chain tensioner and slack side chain guide.



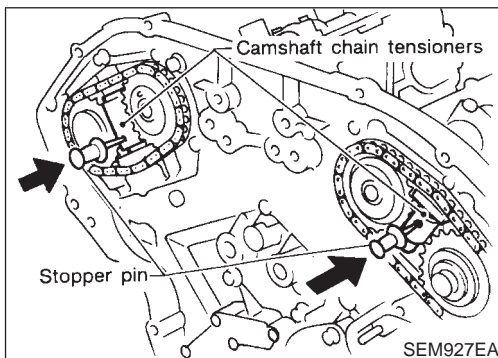
- Remove timing chain tensioner. (Push piston and insert a suitable pin into pinhole.)

TIMING CHAIN

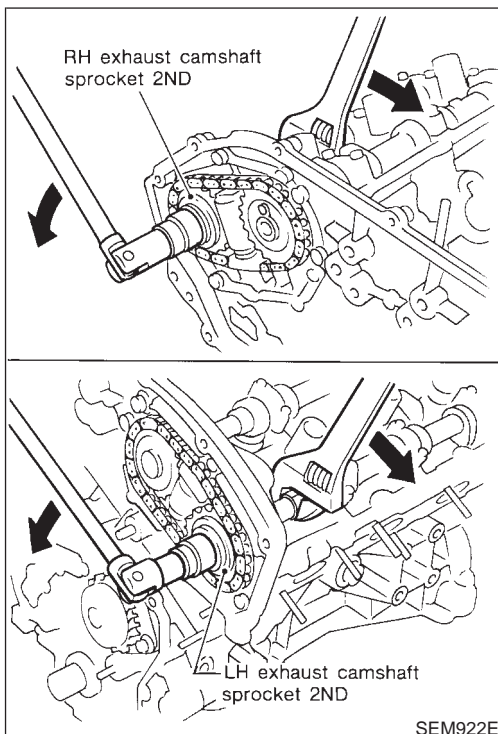
Removal (Cont'd)



33. Remove RH & LH camshaft sprocket 1ST bolts.
34. Remove camshaft sprockets 1ST on both sides, crankshaft sprocket and timing chain.
 - Apply paint to timing chain and camshaft sprockets 1ST for alignment during installation.



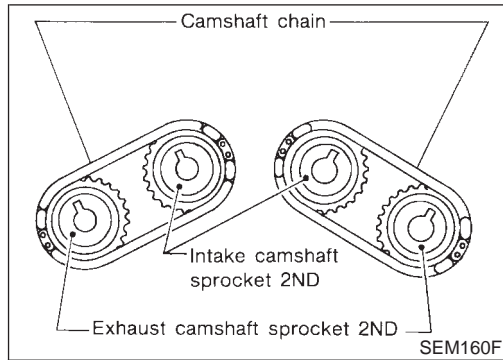
35. Attach a suitable stopper pin to RH and LH camshaft chain tensioners.



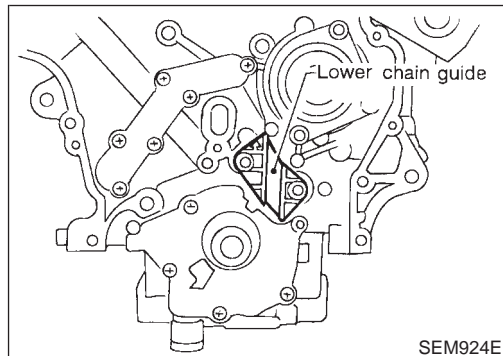
36. Remove exhaust camshaft sprocket 2ND bolts on both sides.
 - Apply paint to timing chain and camshaft sprockets 2ND for alignment during installation.

TIMING CHAIN

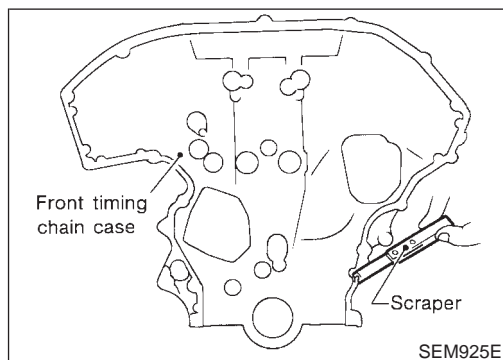
Removal (Cont'd)



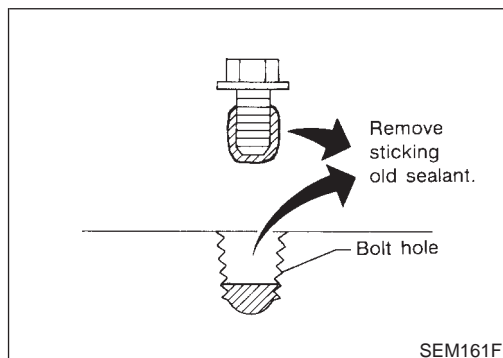
37. Remove exhaust camshaft sprockets 2ND, intake camshaft sprockets 2ND and camshaft chains on both sides.



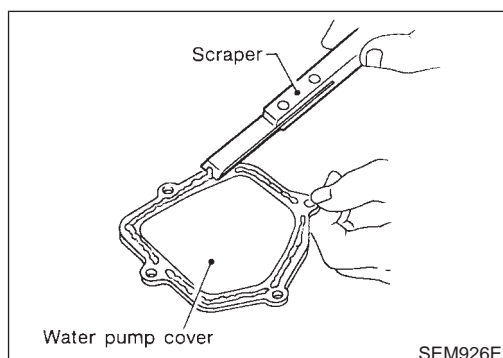
38. Remove lower chain guide.



39. Use a scraper to remove all traces of liquid gasket from front timing chain case.



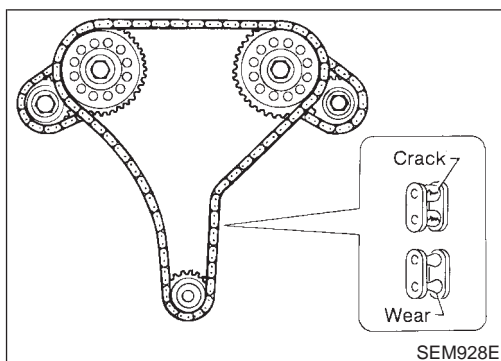
- Remove old liquid gasket from the bolt hole and thread.



40. Use a scraper to remove all traces of liquid gasket from water pump cover.

TIMING CHAIN

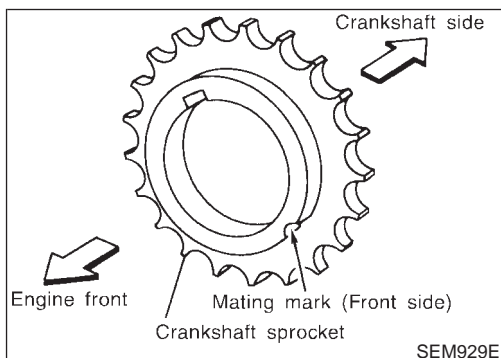
Inspection



Inspection

Check for cracks and excessive wear at roller links. Replace chain if necessary.

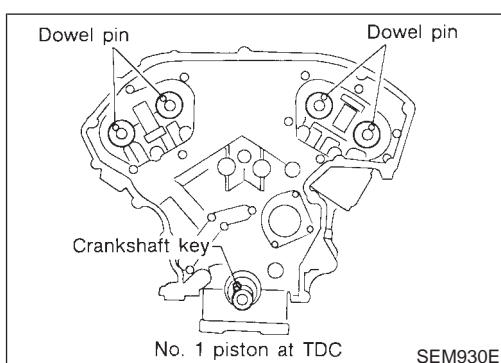
NFEM0013



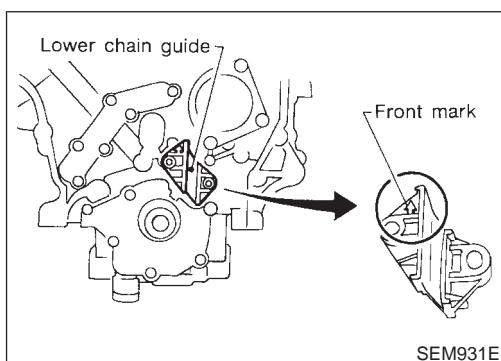
Installation

1. Install crankshaft sprocket on crankshaft.
 - Make sure that mating marks on crankshaft sprocket face front of engine.

NFEM0014



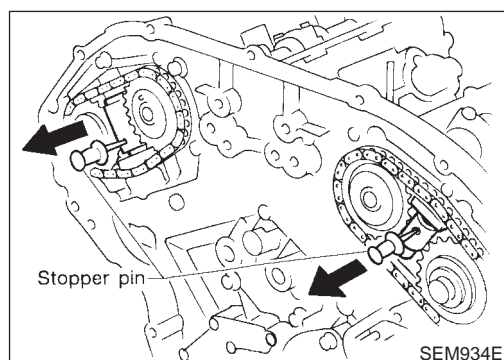
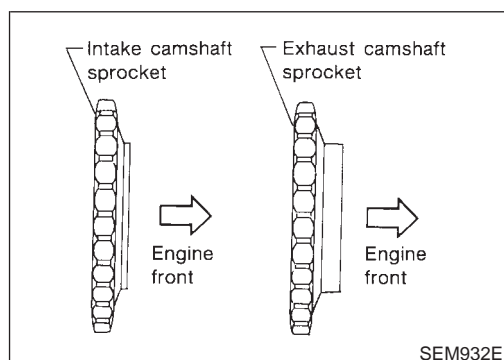
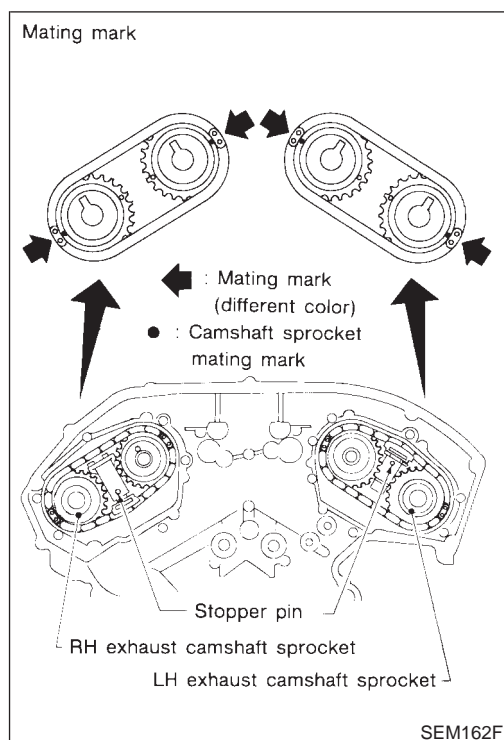
2. Position crankshaft so that No. 1 piston is set at TDC on compression stroke.



3. Install lower chain guide on dowel pin, with front mark on the guide facing upside.

TIMING CHAIN

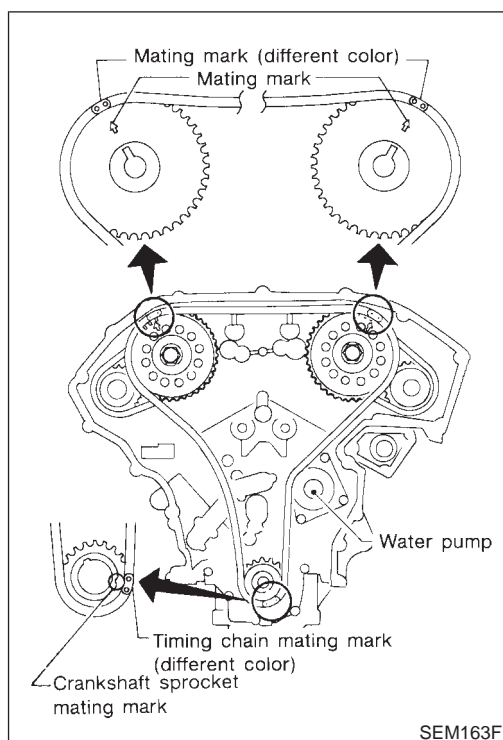
Installation (Cont'd)



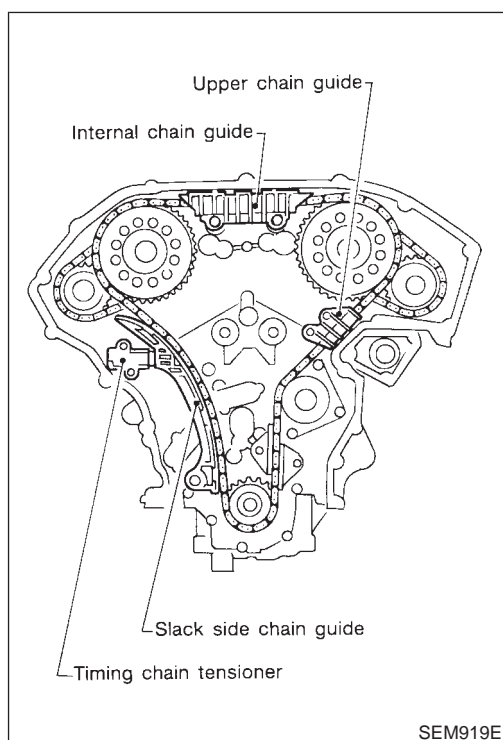
4. Align the marks on RH and LH intake camshaft sprockets 2ND, exhaust camshaft sprockets 2ND and camshaft chain, as shown.
5. Put LH camshaft dowel pin into camshaft sprocket dowel groove and install these on camshaft. Tighten LH exhaust camshaft sprocket 2ND bolt.
6. Put RH camshaft dowel pin in camshaft sprocket dowel groove and install sprocket on camshaft.
7. Tighten RH exhaust camshaft sprocket 2ND bolt.
- **Make sure that the timing marks on RH and LH intake camshaft sprockets 2ND are aligned with the camshaft chain mark.**
- **Lubricate threads and seat surfaces of camshaft sprocket bolts with new engine oil.**
- **Be careful not to confuse intake and exhaust camshaft sprockets 2ND (their thicknesses are different).**
8. Remove RH and LH camshaft chain tensioner stopper pins.

TIMING CHAIN

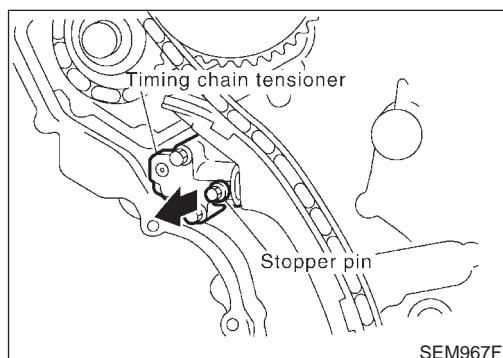
Installation (Cont'd)



9. Align mating mark on crankshaft sprocket with matchmark on chain as shown.
10. Attach lower timing chain on the water pump sprocket.
11. Install RH and LH camshaft sprockets 1ST onto camshafts by matching sprocket dowel grooves with camshaft.
12. Tighten RH and LH camshaft sprocket 1ST bolts.
 - **Lubricate threads and seat surfaces of the bolts with new engine oil.**
13. Install timing chain. Make sure that mating marks on crankshaft sprocket and RH and LH camshaft sprockets are aligned with matchmarks on timing chain.



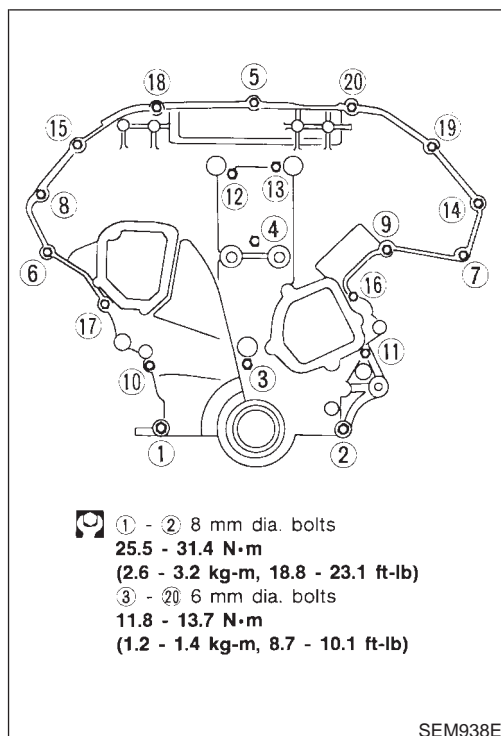
14. Install internal chain guide.
15. Install upper chain guide and slack side chain guide.



16. Install timing chain tensioner, then remove the stopper pin.
 - **When installing the timing chain tensioner, engine oil should be applied to the oil hole and tensioner.**
17. Apply liquid gasket to front timing chain case.
 - Refer to "POSITION FOR APPLYING LIQUID GASKET", EM-19.
 - **Before installation, wipe off the protruding sealant.**

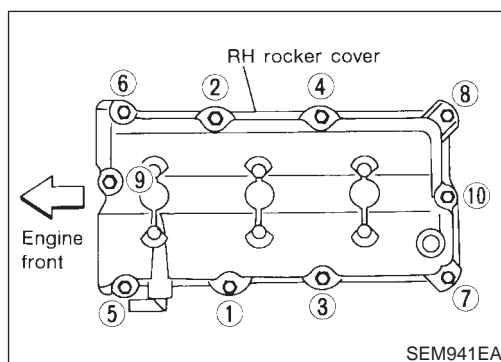
TIMING CHAIN

Installation (Cont'd)



18. Install rear case pin into dowel pin hole on front timing chain case.
19. Tighten bolts to the specified torque in order shown in the figure.
 - **Leave the bolts unattended for 30 minutes or more after tightening.**

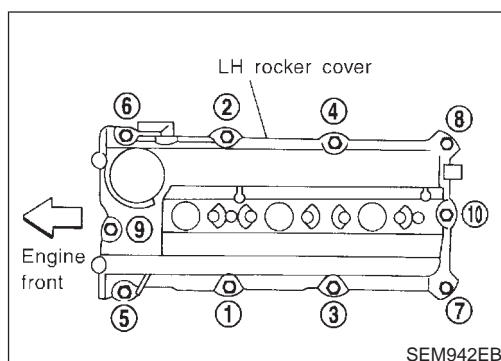
20. Apply liquid gasket to water pump cover.
 - Apply a continuous bead of liquid gasket to mating surface of water pump cover. Refer to LC-15, "Water Pump Installation".
21. Install water pump cover.
22. Apply liquid gasket to RH and LH rocker covers.
 - Use genuine liquid gasket or equivalent.
 - Refer to "POSITION FOR APPLYING LIQUID GASKET", EM-19.



23. Install RH and LH rocker covers.

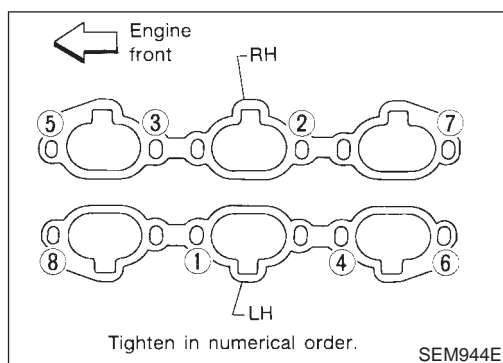
Rocker cover tightening procedure:

 - **Tighten in numerical order as shown in the figure.**
 - a. Tighten bolts 1 to 10 in that order to 6.9 to 8.8 N·m (0.7 to 0.9 kg-m, 61 to 78 in-lb).
 - b. Then tighten bolts 1 to 10 as indicated in figure to 6.9 to 8.8 N·m (0.7 to 0.9 kg-m, 61 to 78 in-lb).

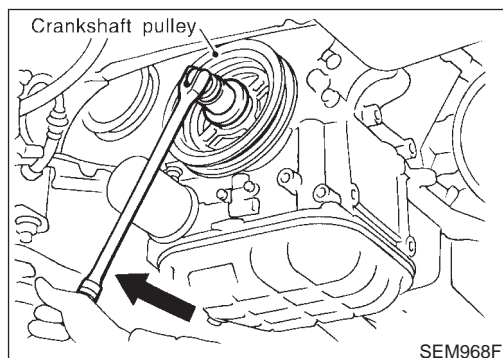


TIMING CHAIN

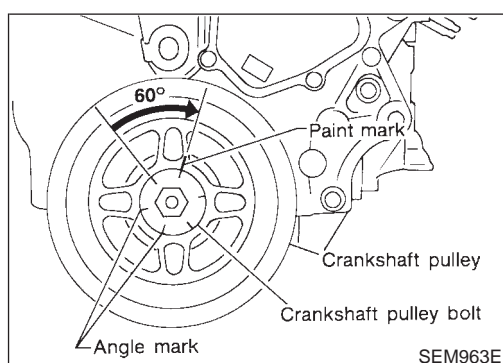
Installation (Cont'd)



24. Install intake manifold. Tighten intake manifold nuts and bolts. **Refer to "TIGHTENING PROCEDURES", EM-10.**
25. Install fuel tube assembly.
26. Install intake manifold collector gasket.
27. Install intake manifold collector supports and intake manifold collector bolt.
28. Install EGR guide tube.
29. Install RH and LH ignition coils.
30. Install rocker cover ornament on left side.

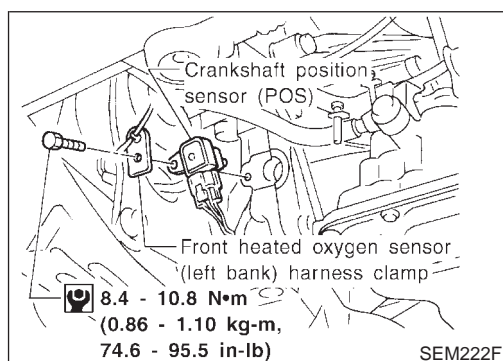


31. Install crankshaft pulley to crankshaft.
 - **Lubricate thread and seat surface of the bolt with new engine oil.**
 - a. Tighten to 39 to 49 N·m (4.0 to 5.0 kg-m, 29 to 36 ft-lb).
 - b. Put a paint mark on the crankshaft pulley.
 - c. Again tighten by turning 60° to 66°, about the angle from one hexagon bolt head corner to another.



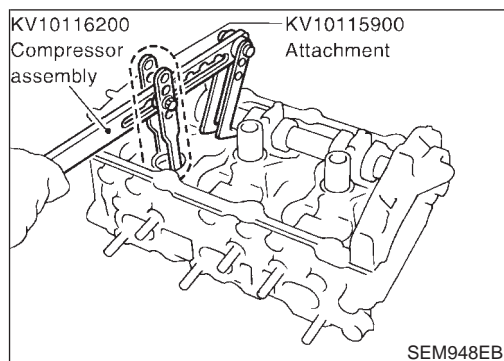
32. Install camshaft position sensor (PHASE), crankshaft position sensors (REF)/(POS) and front heated oxygen sensor (left bank) harness clamp.
 - **Make sure that crankshaft position sensor (POS) and front heated oxygen sensor (left bank) harness clamp are installed correctly as shown in figure.**

33. Reinstall removed parts in reverse order of removal.
 - When installing fuel tube assembly. Refer to EC-38, "REMOVAL AND INSTALLATION", "Injector".
 - **After starting engine, keep idling for three minutes. Then rev engine up to 3,000 rpm under no load to purge air from the high-pressure chamber of the chain tensioners. The engine may produce a rattling noise. This indicates that air still remains in the chamber and is not a matter of concern.**



OIL SEAL

Replacement



Replacement

NFEM0015

CAUTION:

When removing the oil pans, oil pump assembly and timing chain from engine, first remove the camshaft position sensor (PHASE) and the crankshaft position sensors (REF)/(POS) from the assembly.

Be careful not to damage sensor edges.

VALVE OIL SEAL

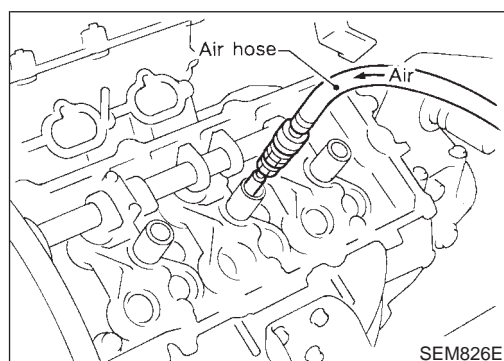
NFEM0015S01

1. Remove LH ornament cover.
2. Remove RH and LH ignition coils.
3. Remove EGR guide tube.
4. Remove intake manifold collector supports and intake manifold collector (RH cylinder head only).
5. Remove RH and LH rocker covers from cylinder head.
6. Remove camshaft position sensor (PHASE) and crankshaft position sensors (REF)/(POS).
7. Remove oil pan. Refer to "Removal", EM-12.
8. Remove timing chain. Refer to "Removal", EM-21.
9. Remove camshaft brackets and camshaft. Refer to "Disassembly", EM-38.
10. Remove valve lifters and shims.
11. Remove valve spring with Tool.
12. Reinstall any parts removed in reverse order of removal.

Before removing valve spring, fix valve as follows.

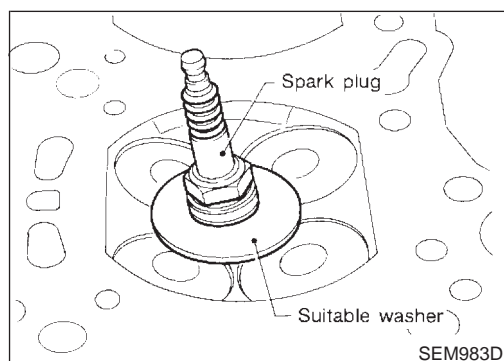
Method A:

Piston concerned should be set at TDC to prevent valve from falling.



Method B:

Remove spark plug, then install air hose adapter into spark plug hole and apply air pressure to hold valves in place. Apply a pressure of 490 kPa (4.9 bar, 5 kg/cm², 71 psi).

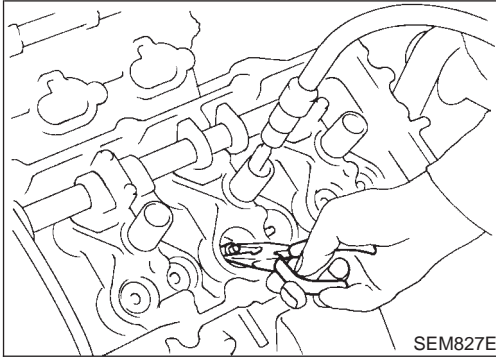


Method C:

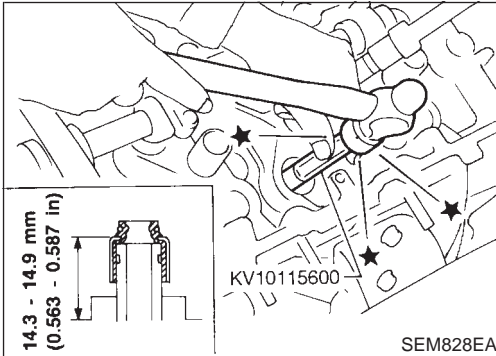
Install spark plug with suitable washer into spark plug hole from combustion chamber side.

OIL SEAL

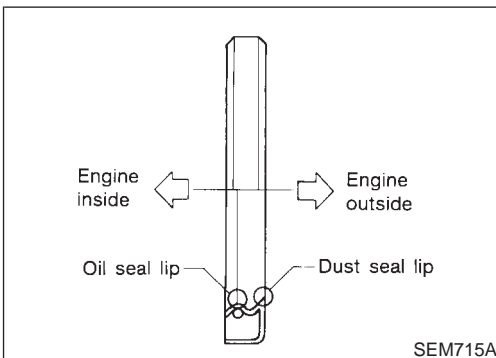
Replacement (Cont'd)



13. Remove valve oil seal.



14. Apply engine oil to new valve oil seal and install it with Tool.



OIL SEAL INSTALLATION DIRECTION

NFEM0015S02

- Install new oil seal in the direction shown in the figure.

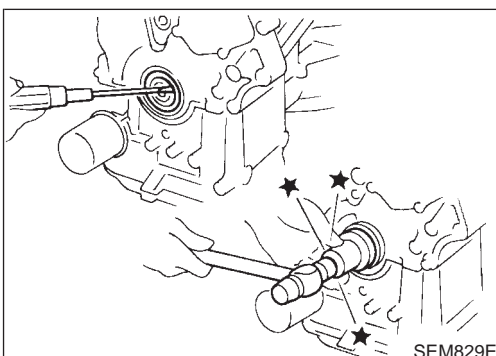
FRONT OIL SEAL

NFEM0015S03

1. Remove the following parts:

- Engine undercover
- Front RH wheel and engine side cover
- Drive belts
- Crankshaft position sensor (REF)
- Crankshaft pulley

Be careful not to damage sensor edge.



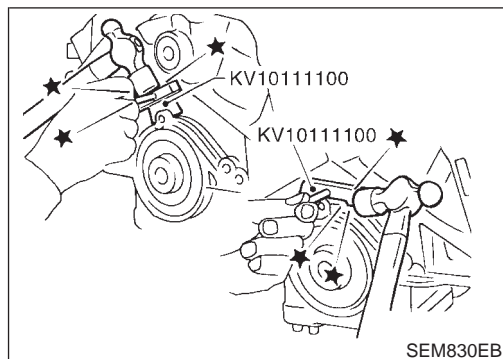
2. Remove front oil seal using a suitable tool.

Be careful not to scratch front cover.

3. Apply engine oil to new oil seal and install it using a suitable tool.

OIL SEAL

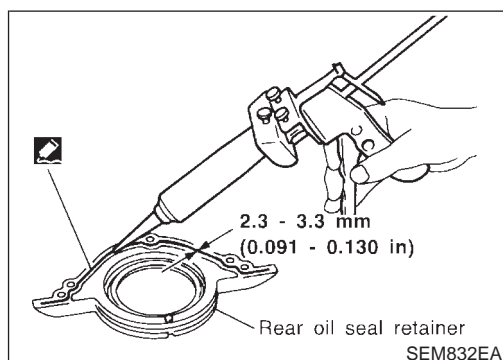
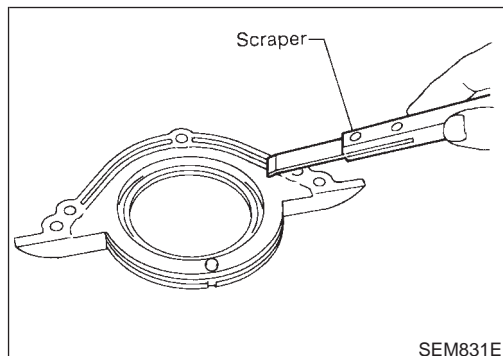
Replacement (Cont'd)



REAR OIL SEAL

NFEM0015S04

1. Remove transaxle. Refer to MT-10 or AT-351.
 2. Remove flywheel or drive plate.
 3. Remove oil pan. Refer to EM-12.
 4. Remove rear oil seal retainer.
-
5. Remove old liquid gasket using scraper.
 - **Remove old liquid gasket from the bolt hole and thread.**
-
6. Apply liquid gasket to rear oil seal retainer.



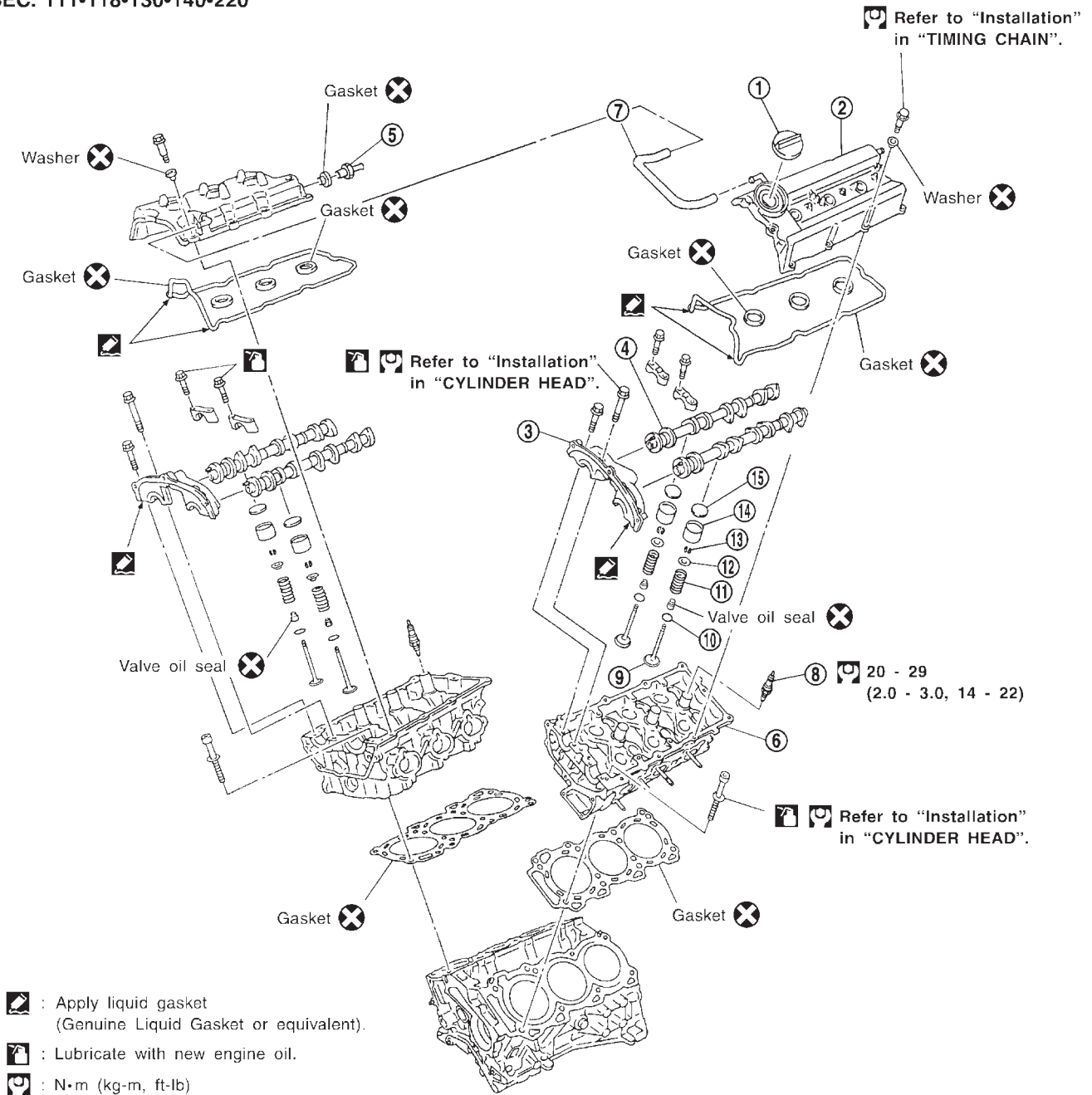
CYLINDER HEAD

Components

NFEM0016

SEC. 111•118•130•140•220

Components



SEM095G

- | | | |
|---------------------|-----------------------|---------------------------|
| 1. Oil filler cap | 6. Cylinder head | 11. Valve spring |
| 2. Rocker cover | 7. Blow-by hose | 12. Valve spring retainer |
| 3. Camshaft bracket | 8. Spark plug | 13. Valve collet |
| 4. Camshaft | 9. Valve | 14. Valve lifter |
| 5. PCV valve | 10. Valve spring seat | 15. Shim |

CYLINDER HEAD

Components (Cont'd)

CAUTION:

- When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Apply new engine oil to threads and seat surfaces when installing cylinder head, camshaft sprocket, crankshaft pulley, and camshaft bracket.
- Attach tags to valve lifters so as not to mix them up.

Removal

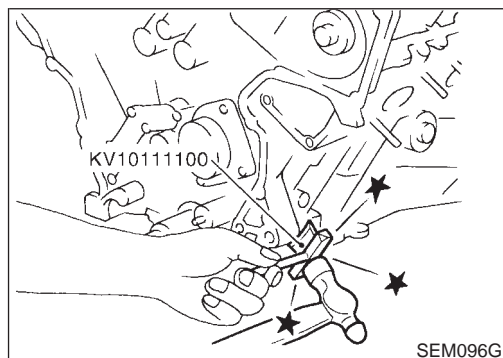
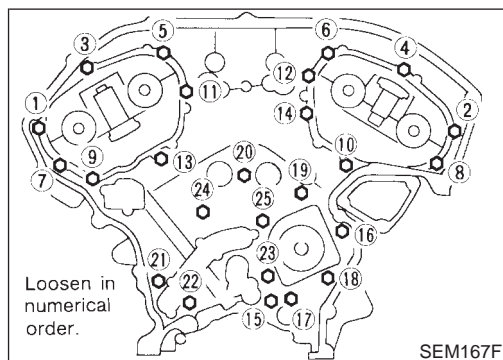
- This removal is the same procedure as that for timing chain. Refer to "Removal", EM-21.
- Apply paint to camshaft sprockets for alignment during installation.

NFEM0017

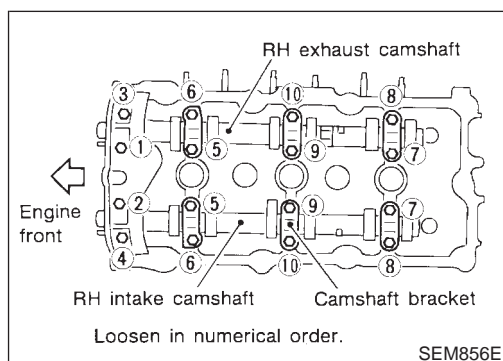
Disassembly

1. Remove rear timing chain case bolts.

NFEM0018



2. Remove rear timing chain case.

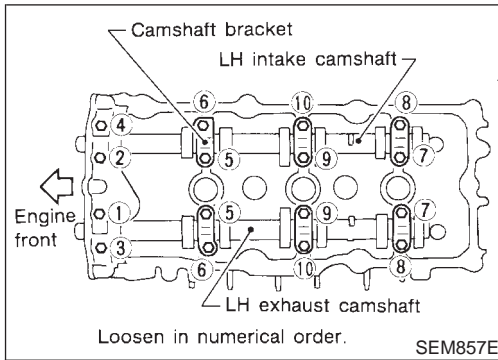


3. Remove intake and exhaust camshafts and camshaft brackets.
 - Equally loosen camshaft bracket bolts in several steps in the numerical order shown in the figure.

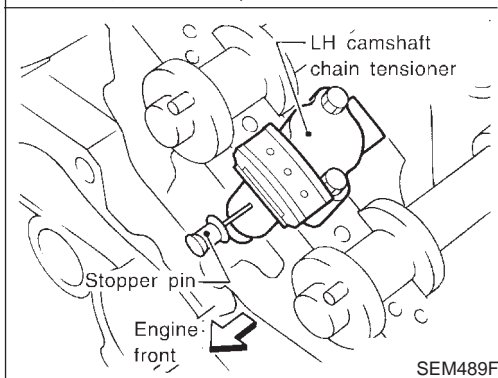
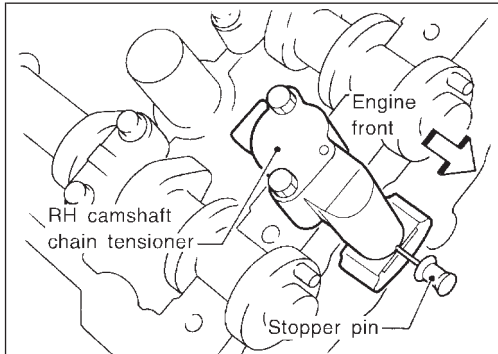
For reinstallation, be sure to put marks on camshaft bracket before removal.
4. Remove valve component parts. Refer to "VALVE OIL SEAL", EM-34.

CYLINDER HEAD

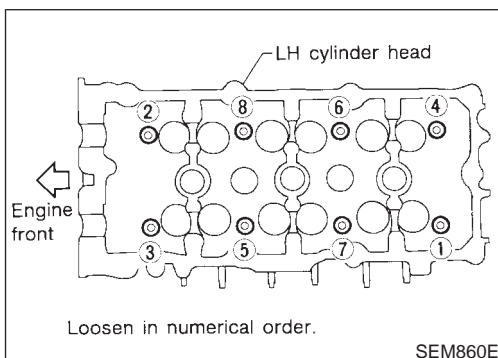
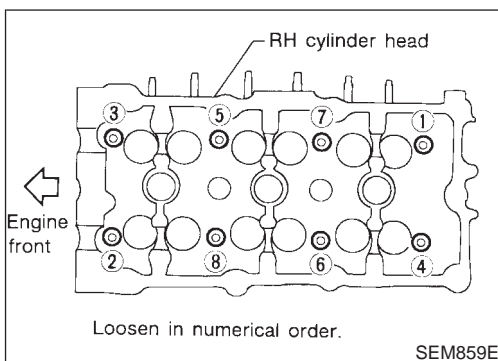
Disassembly (Cont'd)



5. Remove RH and LH camshaft chain tensioners from cylinder head.

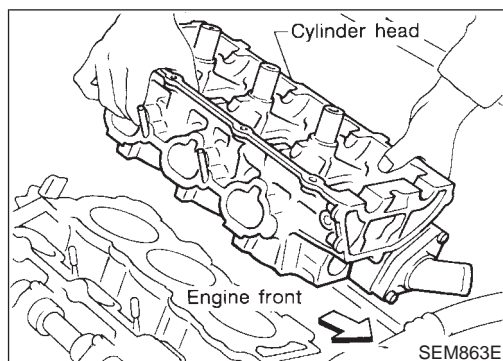


6. Remove cylinder head bolts.
 - **Cylinder head bolts should be loosened in two or three steps.**
 - **A warped or cracked cylinder head could result from removing in incorrect order.**

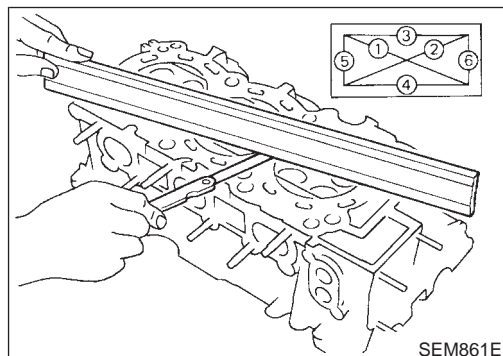


CYLINDER HEAD

Disassembly (Cont'd)



7. Remove cylinder head.



Inspection

CYLINDER HEAD DISTORTION

NFEM0019

NFEM0019S01

Clean surface of cylinder head.

Use a reliable straightedge and feeler gauge to check the flatness of cylinder head surface.

Check along six positions shown in the figure.

Head surface flatness: Limit 0.1 mm (0.004 in)

If beyond the specified limit, resurface or replace it.

The limit for cylinder head resurfacing is determined by the cylinder block resurfacing.

Resurfacing limit:

Amount of cylinder head resurfacing is "A".

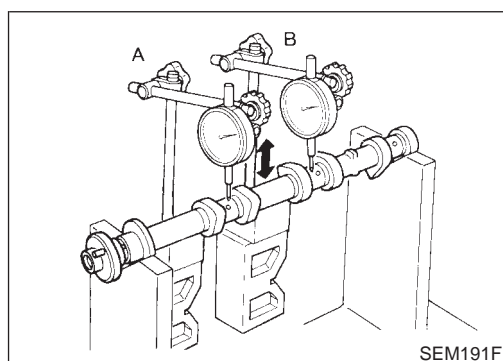
Amount of cylinder block resurfacing is "B".

The maximum limit: $A + B = 0.2 \text{ mm (0.008 in)}$

After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Nominal cylinder head height:

126.3 - 126.5 mm (4.972 - 4.980 in)



CAMSHAFT VISUAL CHECK

NFEM0019S02

Check camshaft for scratches, seizure and wear.

CAMSHAFT RUNOUT

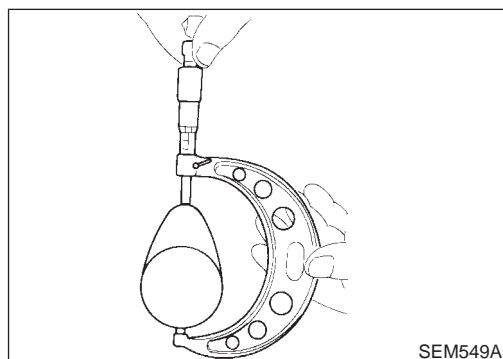
NFEM0019S03

1. Measure camshaft runout at A and B as shown in the figure.

Runout (Total indicator reading):

Limit 0.05 mm (0.0020 in)

2. If it exceeds the limit, replace camshaft.



CAMSHAFT CAM HEIGHT

NFEM0019S04

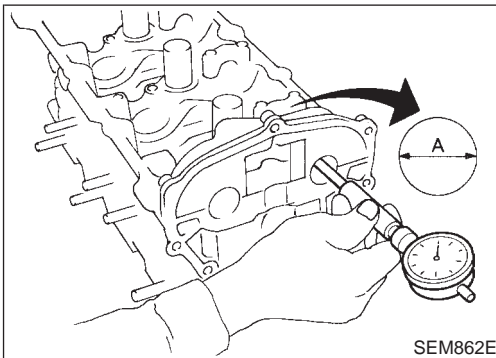
1. Measure camshaft cam height.

CYLINDER HEAD

Inspection (Cont'd)

		Standard cam height	Cam wear limit
VQ20DE	Intake	43.355 - 43.545 mm (1.7069 - 1.7144 in)	0.2 mm (0.008 in)
	Exhaust	43.405 - 43.595 mm (1.7089 - 1.7163 in)	
VQ30DE	Intake	43.940 - 44.130 mm (1.7299 - 1.7374 in)	
	Exhaust	44.465 - 44.655 mm (1.7506 - 1.7581 in)	

- If wear is beyond the limit, replace camshaft.



CAMSHAFT JOURNAL CLEARANCE

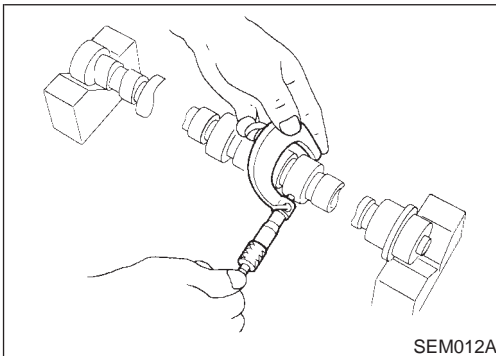
NFEM0019S05

- Install camshaft bracket and tighten bolts to the specified torque.
- Measure inner diameter "A" of camshaft bearing.

Standard inner diameter:

No. 1: 26.000 - 26.021 mm (1.0236 - 1.0244 in)

No. 2, 3, 4: 23.500 - 23.521 mm (0.9252 - 0.9260 in)



- Measure outer diameter of camshaft journal.

Standard outer diameter:

No. 1: 25.935 - 25.955 mm (1.0211 - 1.0218 in)

No. 2, 3, 4: 23.445 - 23.465 mm (0.9230 - 0.9238 in)

- If clearance exceeds the limit, replace camshaft and/or cylinder head.

Camshaft journal clearance:

Standard

No. 1: 0.045 - 0.086 mm (0.0018 - 0.0034 in)

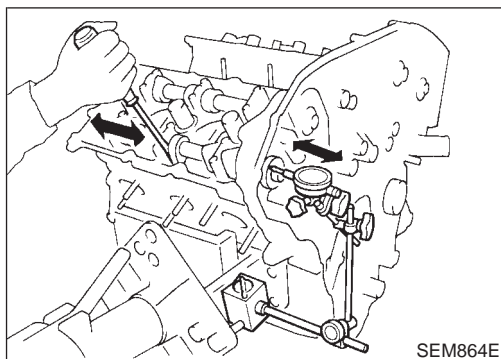
No. 2, 3, 4: 0.035 - 0.076 mm (0.0014 - 0.0030 in)

Limit

0.15 mm (0.0059 in)

CYLINDER HEAD

Inspection (Cont'd)



CAMSHAFT END PLAY

NFEM0019S06

1. Install camshaft in cylinder head.
2. Measure camshaft end play.

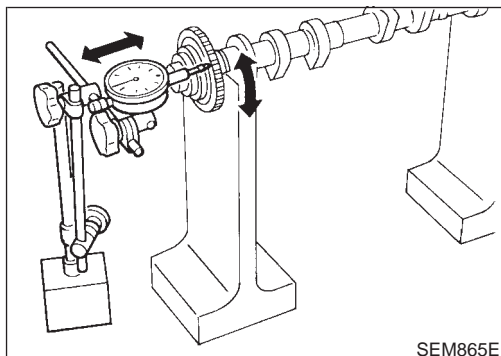
Camshaft end play:

Standard

0.115 - 0.188 mm (0.0045 - 0.0074 in)

Limit

0.24 mm (0.0094 in)

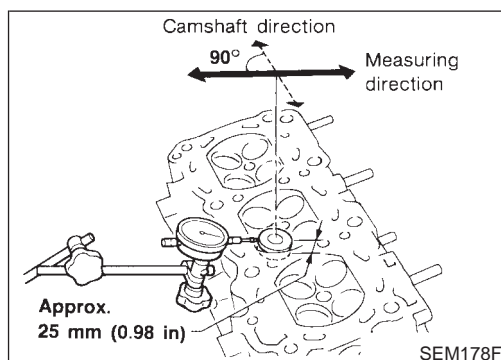


CAMSHAFT SPROCKET RUNOUT

NFEM0019S07

1. Install sprocket on camshaft.
2. Measure camshaft sprocket runout.

Runout (Total indicator reading):
Less than 0.15 mm (0.0059 in)
3. If it exceeds the limit, replace camshaft sprocket.



VALVE GUIDE CLEARANCE

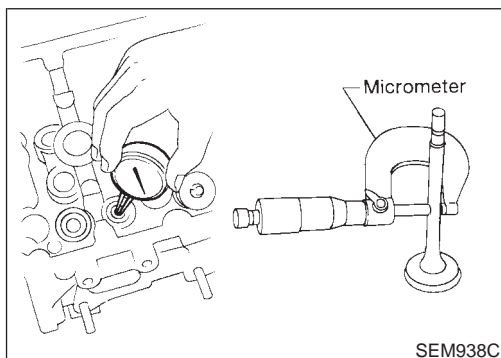
NFEM0019S08

1. Measure valve deflection as shown in the figure. (Valve and valve guide mostly wear in this direction.)

Valve deflection limit (Dial gauge reading):

Intake 0.24 mm (0.0094 in)

Exhaust 0.28 mm (0.0110 in)



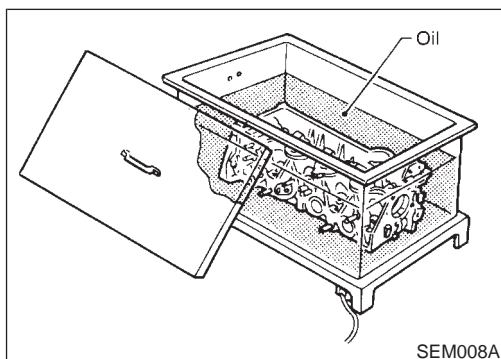
2. If it exceeds the limit, check valve to valve guide clearance.
 - a. Measure valve stem diameter and valve guide inner diameter.
 - b. Check that clearance is within specification.

Valve to valve guide clearance limit:

Intake 0.08 mm (0.0031 in)

Exhaust 0.1 mm (0.004 in)

- c. If it exceeds the limit, replace valve or valve guide.



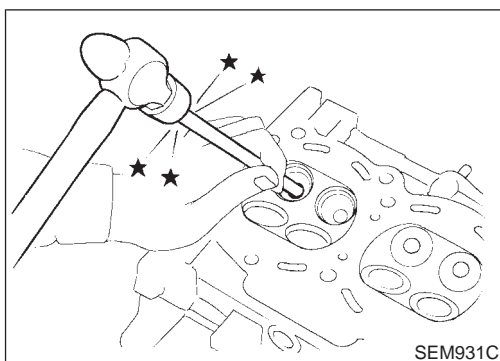
VALVE GUIDE REPLACEMENT

NFEM0019S09

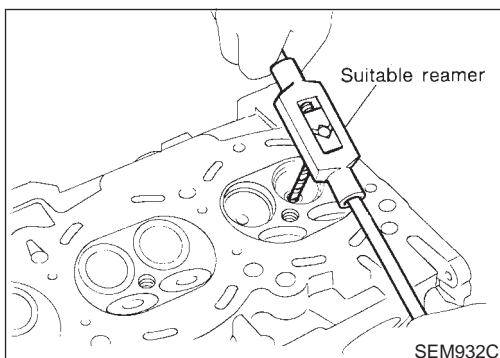
1. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.

CYLINDER HEAD

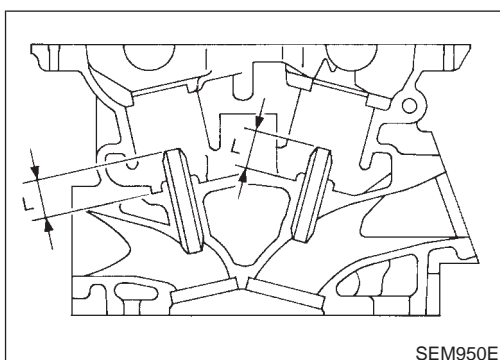
Inspection (Cont'd)



2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or hammer and suitable tool.



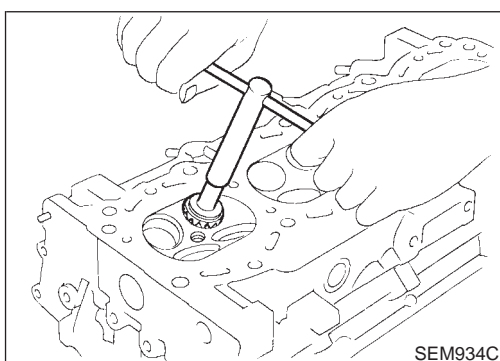
3. Ream cylinder head valve guide hole.
Valve guide hole diameter (for service parts):
10.175 - 10.196 mm (0.4006 - 0.4014 in)



4. Heat cylinder head to 110 to 130°C (230 to 266°F) and press service valve guide onto cylinder head.

Projection "L":
12.6 - 12.8 mm (0.496 - 0.504 in)

5. Ream valve guide.
Finished size:
6.000 - 6.018 mm (0.2362 - 0.2369 in)



VALVE SEATS

Check valve seats for any evidence of pitting at valve contact surface, and reseat or replace if it has worn out excessively.

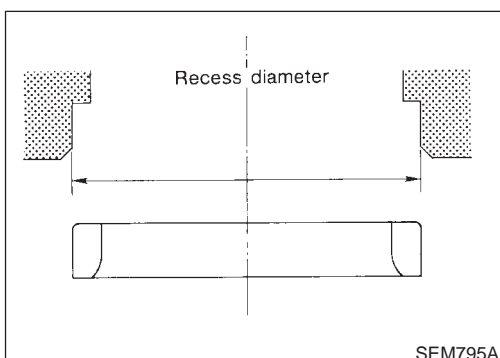
- Before repairing valve seats, check valve and valve guide for wear. If they have worn, replace them. Then correct valve seat.
- Use both hands to cut uniformly.

REPLACING VALVE SEAT FOR SERVICE PARTS

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess for service valve seat.

Upsize [0.5 mm (0.020 in)]:

VQ20DE	Intake	30.500 - 30.516 mm (1.2008 - 1.2014 in)
	Exhaust	25.500 - 25.516 mm (1.0039 - 1.0046 in)



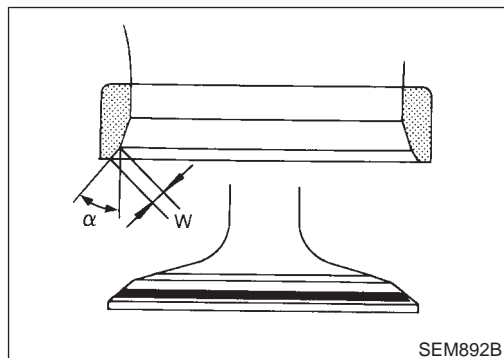
CYLINDER HEAD

Inspection (Cont'd)

VQ30DE	Intake	37.500 - 37.516 mm (1.4764 - 1.4770 in)
	Exhaust	32.700 - 32.716 mm (1.2874 - 1.2880 in)

Be sure to ream in circles concentric to the valve guide center.

This will enable valve seat to fit correctly.



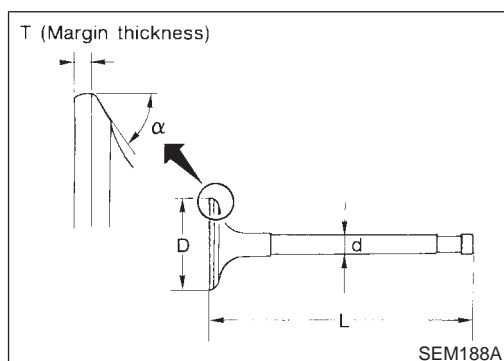
- Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.
- Press fit valve seat until it seats on the bottom.
- Cut or grind valve seat using suitable tool to the specified dimensions as shown in SDS (EM-78).
- After cutting, lap valve seat with abrasive compound.
- Check valve seating condition.

Seat face angle " α ": 45°

Contacting width " W ":

Intake 1.09 - 1.31 mm (0.0429 - 0.0516 in)

Exhaust 1.29 - 1.51 mm (0.0508 - 0.0594 in)



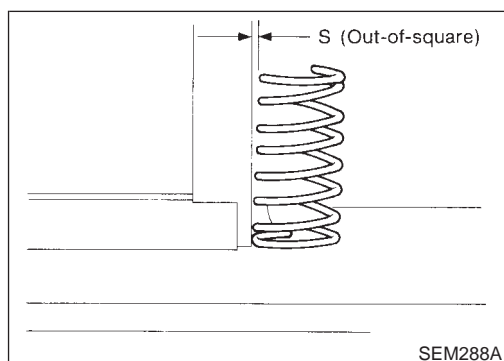
VALVE DIMENSIONS

Check dimensions of each valve. For dimensions, refer to SDS (EM-73).

When valve head has been worn down to 0.5 mm (0.020 in) in margin thickness, replace valve.

Grinding allowance for valve stem tip is 0.2 mm (0.008 in) or less.

NFEM0019S12



VALVE SPRING

Squareness

- Measure dimension " S ".

Out-of-square " S ":

VQ20DE	Less than 2.3 mm (0.091 in)
VQ30DE	Less than 2.1 mm (0.083 in)

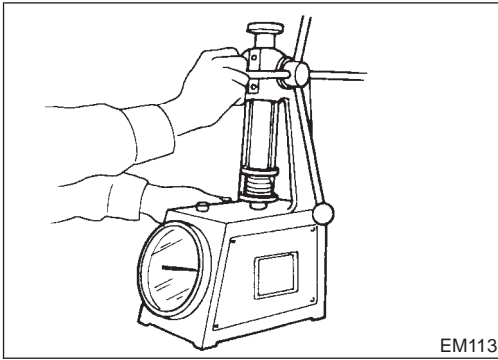
- If it exceeds the limit, replace spring.

NFEM0019S13

NFEM0019S1301

CYLINDER HEAD

Inspection (Cont'd)



Pressure

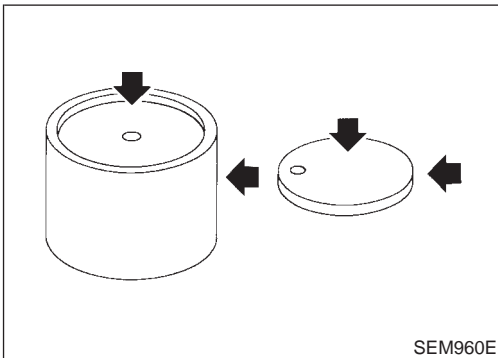
Check valve spring pressure at specified spring height.

NFEM0019S1302

Pressure:

Engine	VQ20DE	VQ30DE
Standard	167 N (17 kg, 37 lb) at height 37.0 mm (1.457 in)	202 N (20.6 kg, 45.4 lb) at height 37.0 mm (1.457 in)
Limit	More than 298 N (30.4 kg, 67.0 lb) at height 29.25 mm (1.1516 in)	More than 436 N (44.5 kg, 98.1 lb) at height 28.2 mm (1.110 in)

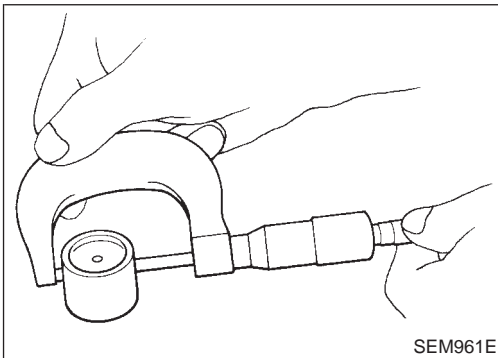
If it exceeds the limit, replace spring.



VALVE LIFTER

1. Check contact and sliding surfaces for wear or scratches.

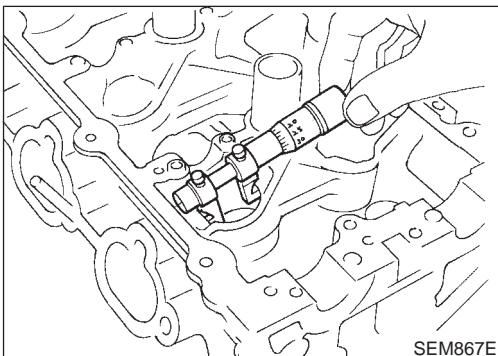
NFEM0019S14



2. Check diameter of valve lifter and valve lifter guide bore.

Valve lifter outer diameter:

VQ20DE	29.965 - 29.975 mm (1.1797 - 1.1801 in)
VQ30DE	34.960 - 34.975 mm (1.3764 - 1.3770 in)

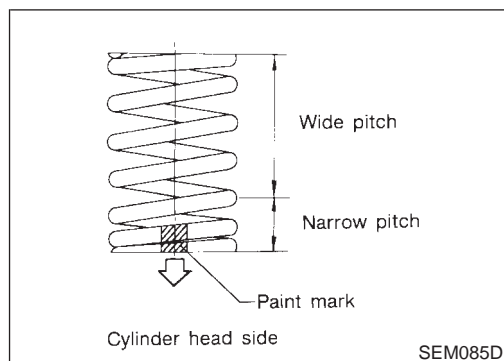


Lifter guide inner diameter:

VQ20DE	IN	30.015 - 30.036 mm (1.1817 - 1.1825 in)
	EX	30.003 - 30.024 mm (1.1812 - 1.1820 in)
VQ30DE		35.000 - 35.021 mm (1.3780 - 1.3788 in)

CYLINDER HEAD

Assembly



Assembly

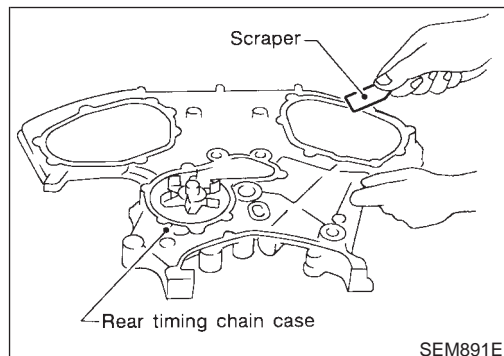
NFEM0020

1. Install valve component parts.
- **Always use new valve oil seal. Refer to “VALVE OIL SEAL”, EM-34.**
- **Before installing valve oil seal, install valve spring seat.**
- **Install valve spring (uneven pitch type) with its narrow pitch side toward cylinder head side (paint mark).**
- After installing valve component parts, tap valve stem tip with plastic hammer to assure a proper fit.

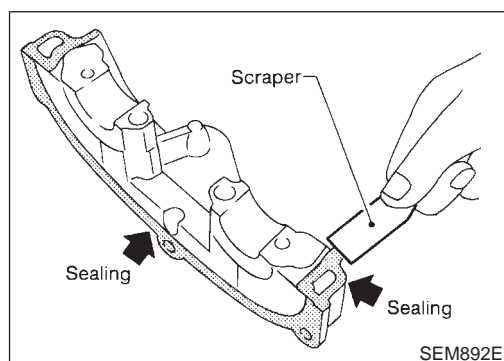
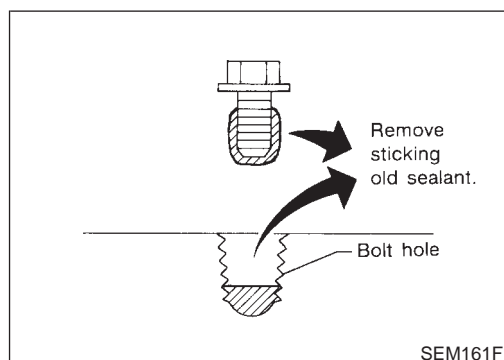
Installation

NFEM0021

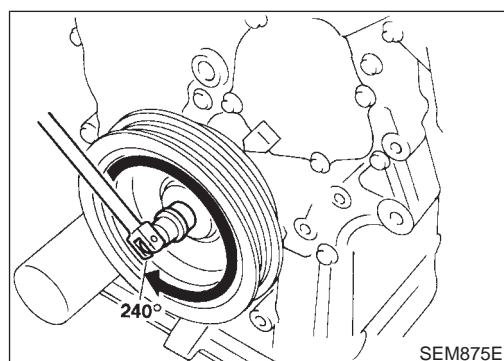
1. Before installing rear timing chain case, remove old liquid gasket from mating surface using a scraper.
- Also remove old liquid gasket from mating surface of cylinder block.



- **Remove old liquid gasket from the bolt hole and thread.**



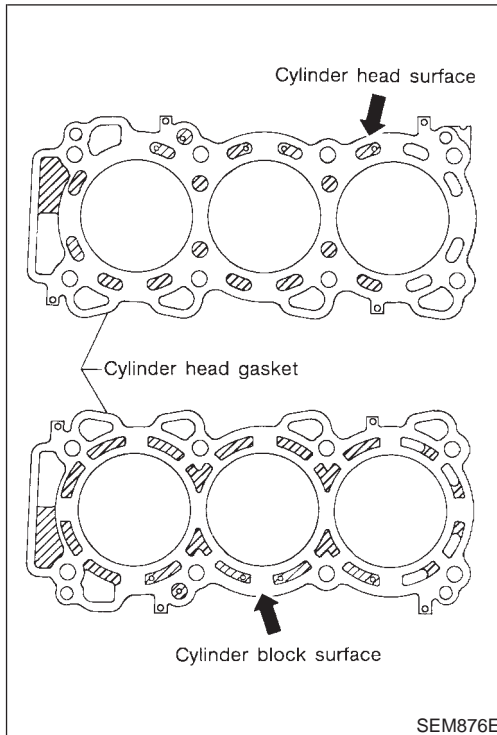
2. Before installing cam bracket, remove old liquid gasket from mating surface using a scraper.
3. Remove O-rings from cylinder block.



4. Turn crankshaft until No. 1 piston is set at approximately 240° before TDC on compression stroke to prevent interference of valves and pistons.

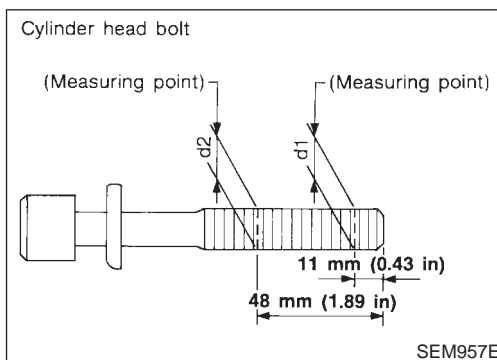
CYLINDER HEAD

Installation (Cont'd)



5. Install cylinder heads with new gaskets.

- Do not rotate crankshaft and camshaft separately, or valves will strike piston heads.



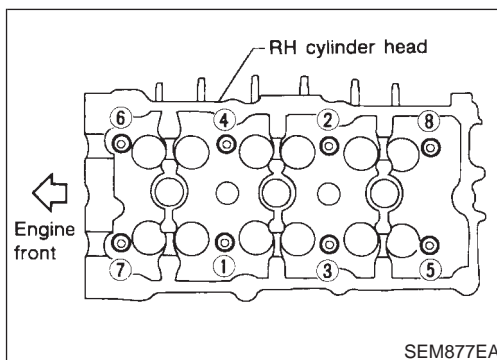
CAUTION:

Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between d1 and d2 exceeds the limit, replace them with new ones.

Limit (d1 - d2):

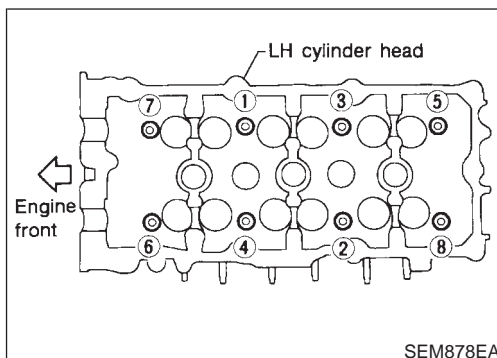
0.11 mm (0.0043 in)

- Lubricate threads and seat surfaces of the bolts with new engine oil.



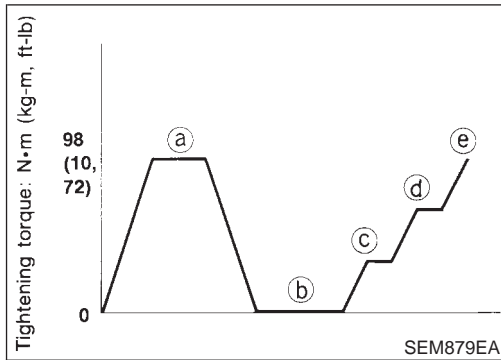
- Tightening procedure:

- Tighten all bolts to 98 N·m (10 kg-m, 72 ft-lb).
 - Completely loosen all bolts.
 - Tighten all bolts to 34 to 44 N·m (3.5 to 4.5 kg-m, 25 to 33 ft-lb).
 - Turn all bolts 90 to 95 degrees clockwise.
 - Turn all bolts 90 to 95 degrees clockwise.
- Tighten in numerical order shown in the figure.

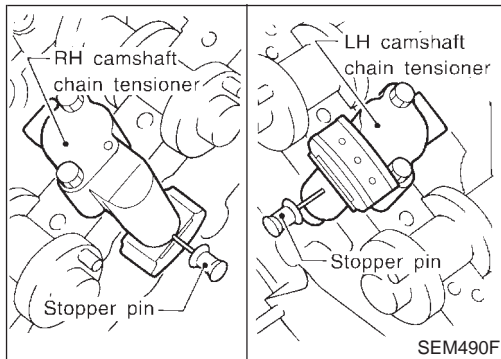


CYLINDER HEAD

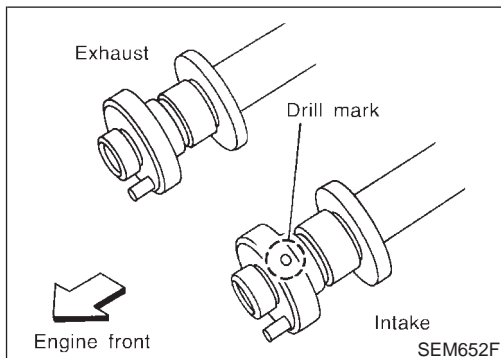
Installation (Cont'd)



6. Install cylinder head outside bolts.

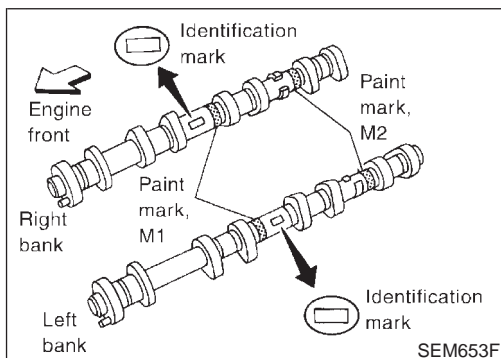


7. Install camshaft chain tensioners on both sides of cylinder head.



8. Install exhaust and intake camshafts and camshaft brackets.

- **Intake camshaft has a drill mark on camshaft sprocket mounting flange. Install it on the intake side.**

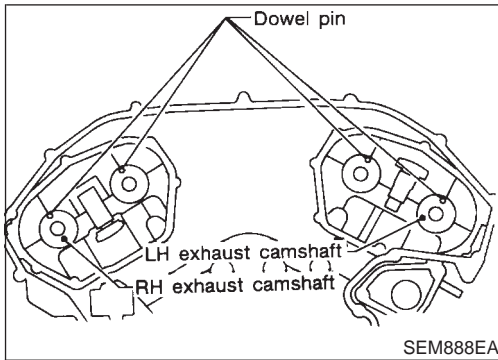


- **Identification marks are present on camshafts.**

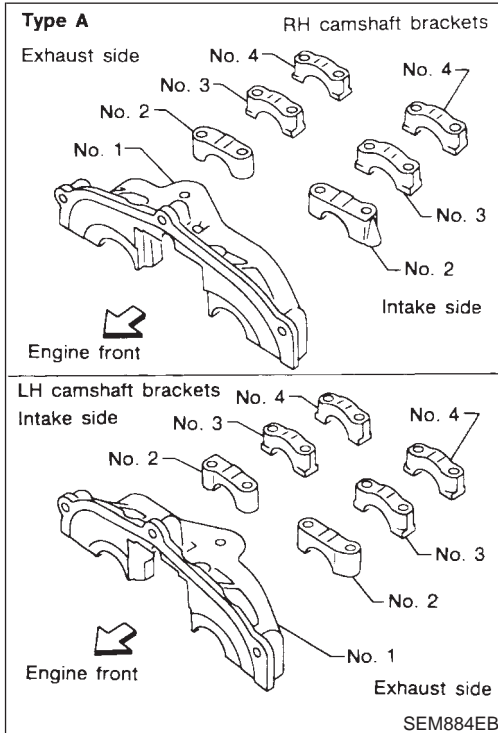
Engine	Bank	INT/EXH	ID mark	Drill mark	Paint mark	
					M1	M2
VQ20DE	RH	INT	R2	Yes	Yes	No
		EXH	R2	No	No	Yes
	LH	INT	L2	Yes	Yes	No
		EXH	L2	No	No	Yes
VQ30DE	RH	INT	R3	Yes	Yes	No
		EXH	R3	No	No	Yes
	LH	INT	L3	Yes	Yes	No
		EXH	L3	No	No	Yes

CYLINDER HEAD

Installation (Cont'd)



- **Position camshaft**
RH exhaust camshaft dowel pin at about 10 o'clock
LH exhaust camshaft dowel pin at about 2 o'clock



- Before installing camshaft brackets, apply sealant to mating surface of No. 1 journal head.
- **Use Genuine Liquid Gasket or equivalent.**
 - **Refer to "POSITION FOR APPLYING LIQUID GASKET", EM-19.**
 - **Install camshaft brackets in their original positions.**
 - **Tighten camshaft bracket bolts gradually in two or three stages.**
 - **If any part of valve assembly or camshaft is replaced, check valve clearance according to reference data. After completing assembly check valve clearance. Refer to "Checking" and "Adjusting" in "VALVE CLEARANCE", EM-51 and 53.**

Reference data valve clearance (Cold):

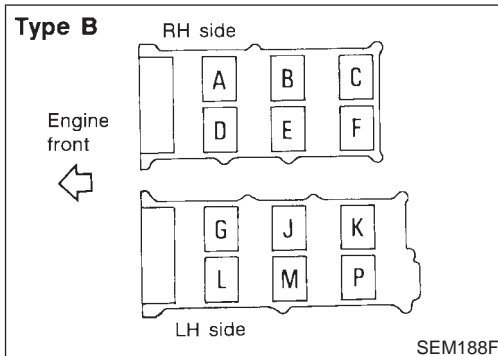
Intake

0.26 - 0.34 mm (0.010 - 0.013 in)

Exhaust

0.29 - 0.37 mm (0.011 - 0.015 in)

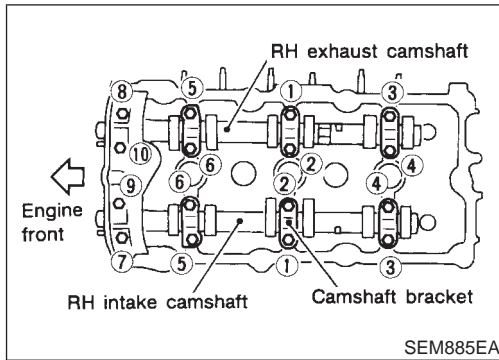
- **Lubricate threads and seat surfaces of camshaft bracket bolts with new engine oil before installing them.**



- **Align stamp mark as shown in the figure.**

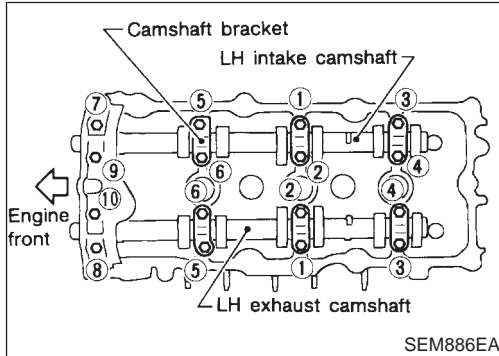
CYLINDER HEAD

Installation (Cont'd)

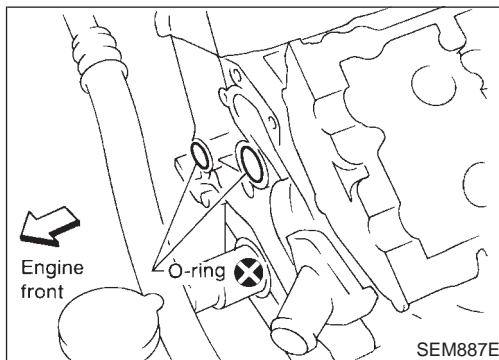


- Tighten the camshaft brackets in the following steps.

Step	Tightening torque	Tightening order
1	1.96 N·m (0.2 kg-m, 17 in-lb)	Tighten in the order of 7 to 10, then tighten 1 to 6.
2	6 N·m (0.6 kg-m, 52 in-lb)	Tighten in the numerical order.
3	9.02 - 11.8 N·m (0.92 - 1.20 kg-m, 79.9 - 104.2 in-lb)	Tighten in the numerical order.



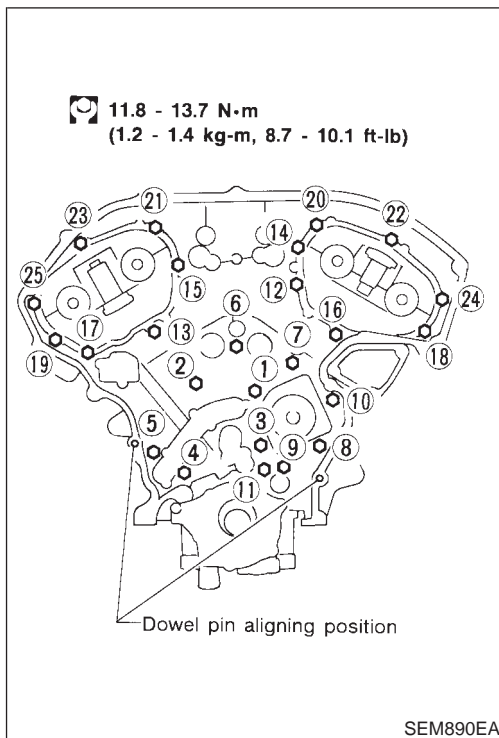
10. Install O-rings to cylinder block.



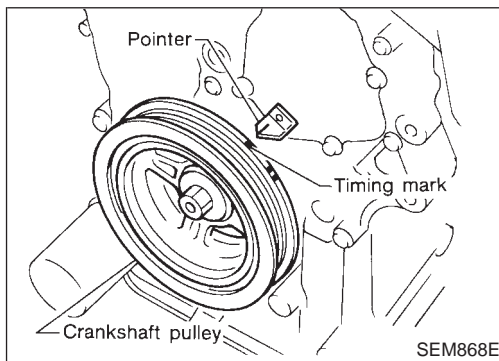
11. Apply sealant to the hatched portion of rear timing chain case.
 - Apply continuous bead of liquid gasket to mating surface of rear timing chain case.
Refer to "POSITION FOR APPLYING LIQUID GASKET", EM-19.
 - **Before installation, wipe off the protruding sealant.**

CYLINDER HEAD

Installation (Cont'd)



12. Align rear timing chain case with dowel pins, then install on cylinder head and block.
13. Tighten rear chain case bolts.
 - a. Tighten bolts in numerical order shown in the figure.
 - b. Repeat above step a.
- This installation is the same procedure as that for timing chain. Refer to "Installation", EM-29.



Valve Clearance CHECKING

NFEM0022

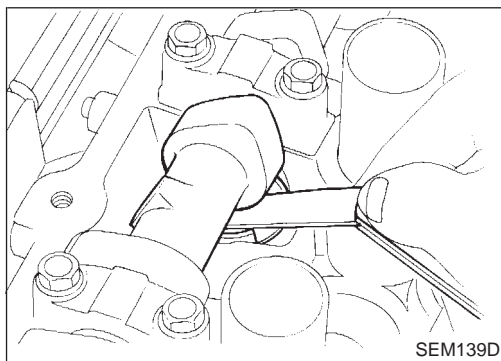
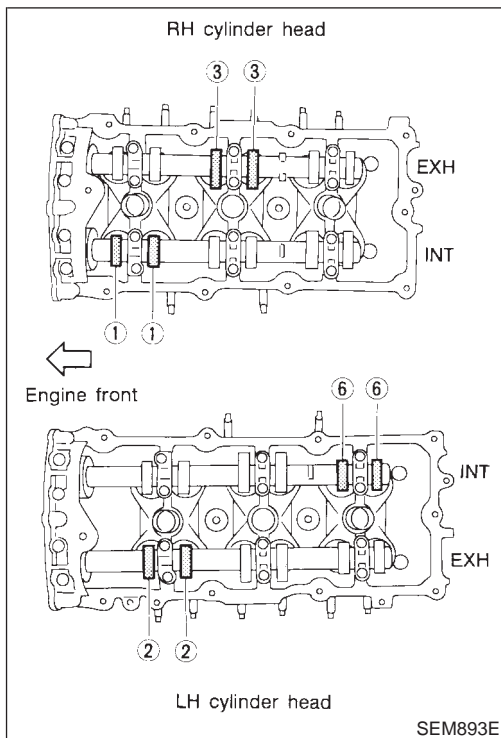
NFEM0022S01

Check valve clearance while engine is cold and not running.

1. Remove intake manifold collector.
 2. Remove rocker cover ornament.
 3. Remove RH and LH rocker covers.
 4. Remove all spark plugs.
 5. Set No. 1 cylinder at TDC on its compression stroke.
 - Align pointer with TDC mark on crankshaft pulley.
 - Check that valve lifters on No. 1 cylinder are loose and valve lifters on No. 4 are tight.
- If not, turn crankshaft one revolution (360°) and align as above.

CYLINDER HEAD

Valve Clearance (Cont'd)



6. Check only those valves shown in the figure.

Crank position	Valve											
	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 1 TDC	○			○		○					○	

- Using a feeler gauge, measure clearance between valve lifter and camshaft.
- Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement adjusting shim.

Valve clearance for checking (Cold):

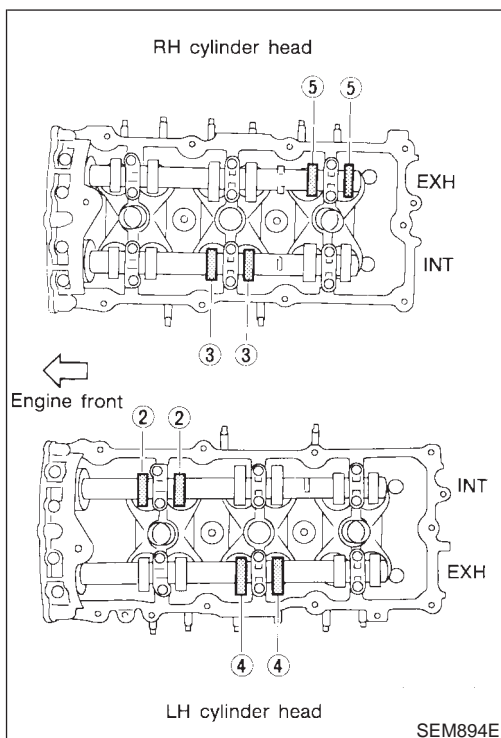
Intake

0.26 - 0.34 mm (0.010 - 0.013 in)

Exhaust

0.29 - 0.37 mm (0.011 - 0.015 in)

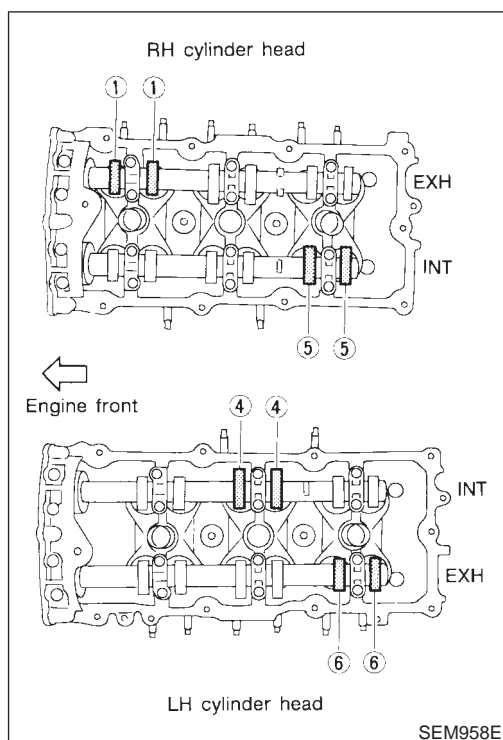
- Turn crankshaft 240° and align as above.
- Set No. 3 cylinder at TDC on its compression stroke.
- Check only those valves shown in the figure.



Crank position	Valve											
	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 3 TDC			○		○		○		○			

CYLINDER HEAD

Valve Clearance (Cont'd)



10. Turn crankshaft 240° and align as above.
11. Set No. 5 cylinder at TDC on its compression stroke.
12. Check only those valves shown in the figure.

Crank position	Valve											
	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH	INT	EXH
No. 5 TDC		○					○		○			○

13. If all valve clearances are within specification, install the following parts.

- Intake manifold collector
- RH and LH rocker covers
- All spark plugs
- Rocker cover ornament

ADJUSTING

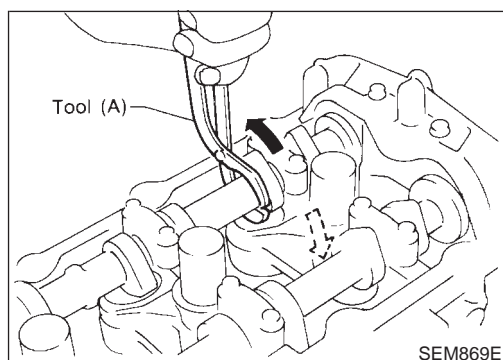
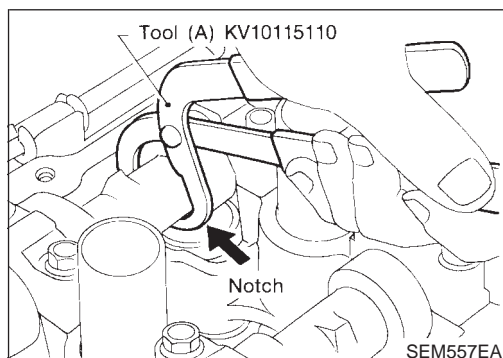
NFEM0022S02

Adjust valve clearance while engine is cold.

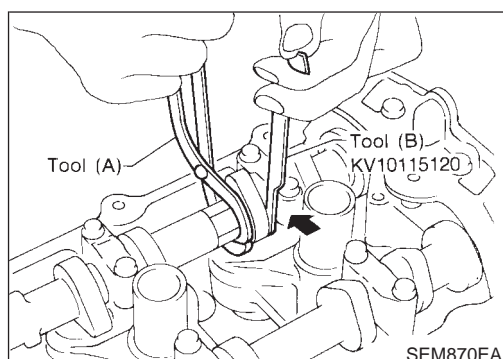
1. Turn crankshaft, to position cam lobe on camshaft of valve that must be adjusted upward.
2. Place Tool (A) around camshaft as shown in figure.
Before placing Tool (A), rotate notch toward center of cylinder head (See figure.), to simplify shim removal later.

CAUTION:

Be careful not to damage cam surface with Tool (A).



3. Rotate Tool (A) (See figure.) so that valve lifter is pushed down.



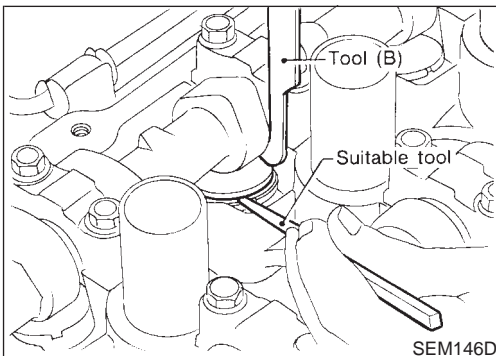
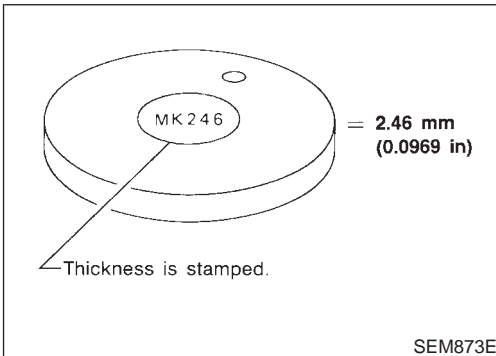
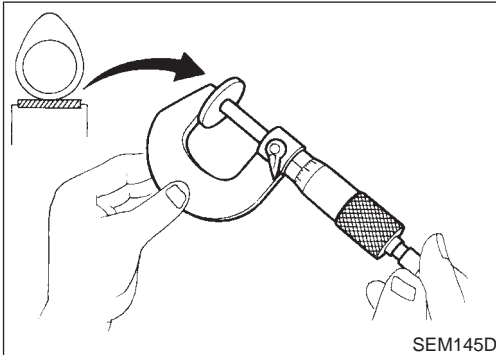
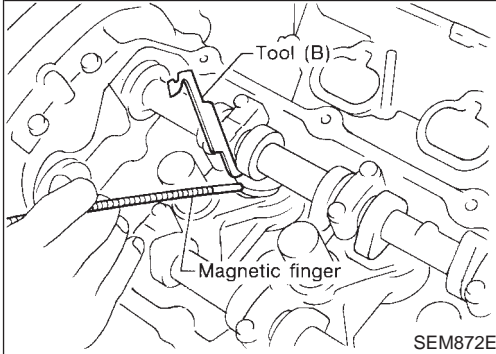
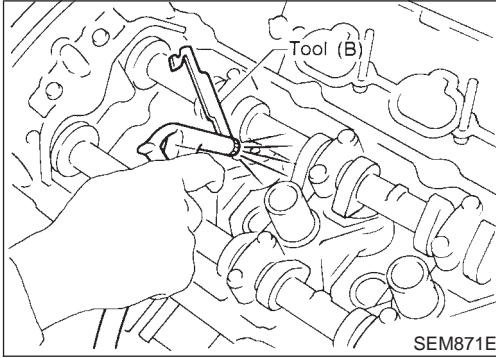
4. Place Tool (B) between camshaft and the edge of the valve lifter to retain valve lifter.

CAUTION:

- Tool (B) must be placed as close to camshaft bracket as possible.
 - Be careful not to damage cam surface with Tool (B).
5. Remove Tool (A).

CYLINDER HEAD

Valve Clearance (Cont'd)



6. Blow air into the hole to separate adjusting shim from valve lifter.

7. Remove adjusting shim using a small screwdriver and a magnetic finger.

8. Determine replacement adjusting shim size following formula.

- Using a micrometer determine thickness of removed shim.
 - Calculate thickness of new adjusting shim so valve clearance comes within specified values.
- R = Thickness of removed shim
N = Thickness of new shim
M = Measured valve clearance

Intake:

$$N = R + [M - 0.30 \text{ mm (0.0118 in)}]$$

Exhaust:

$$N = R + [M - 0.33 \text{ mm (0.0130 in)}]$$

Shims are available in 64 sizes from 2.32 mm (0.0913 in) to 2.95 mm (0.1161 in), in steps of 0.01 mm (0.0004 in).

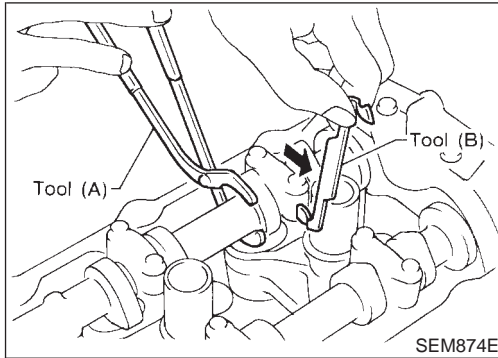
- Select new shim with thickness as close as possible to calculated value.

9. Install new shim using a suitable tool.

- Install with the surface on which the thickness is stamped facing down.

CYLINDER HEAD

Valve Clearance (Cont'd)



10. Place Tool (A) as mentioned in steps 2 and 3.
11. Remove Tool (B).
12. Remove Tool (A).
13. Recheck valve clearance.

Valve clearance:

Unit: mm (in)

	Cold	Hot* (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

Removal and Installation

NFFM0023

SEC. 112



- WARNING:**

- EM-56**

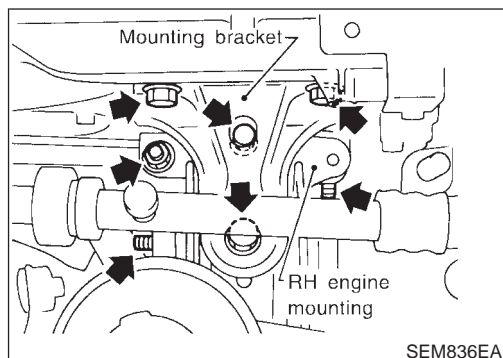
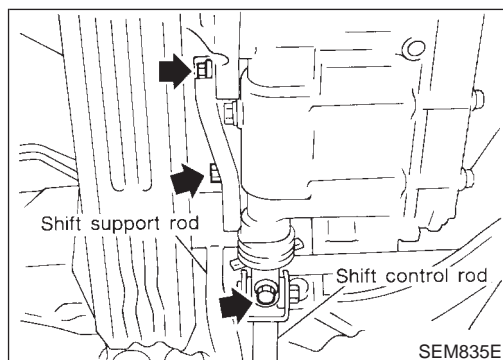
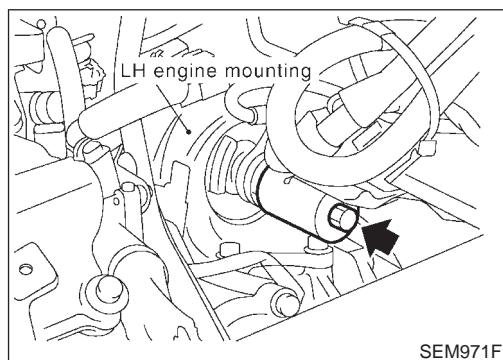
ENGINE ASSEMBLY

Removal and Installation (Cont'd)

- Before disconnecting fuel hose, release fuel pressure from fuel line.
Refer to EC-36, "Fuel Pressure Release".
- Before removing front axle from transaxle, place safety stands under designated front supporting points. Refer to GI-46, "Garage Jack and Safety Stand".
- Be sure to hoist engine and transaxle in a safe manner.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- When lifting engine, be careful not to strike adjacent parts, especially the following: Accelerator wire casing, brake lines, and brake master cylinder.
- In hoisting the engine, always use engine slingers in a safe manner.
- In removing drive shaft, be careful not to damage grease seal of transaxle.
- Before separating engine and transaxle, remove the crankshaft position sensor (POS) from the assembly.
- Always pay extra attention not to damage edge of crankshaft position sensor (POS) or ring gear teeth.



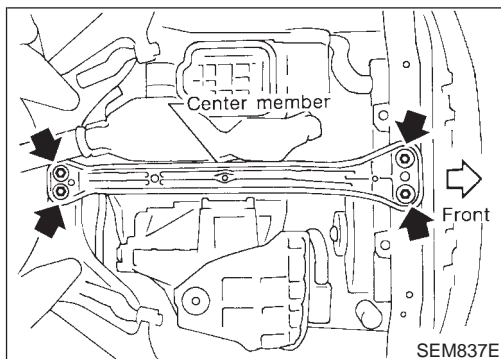
REMOVAL

NFEM0023S01

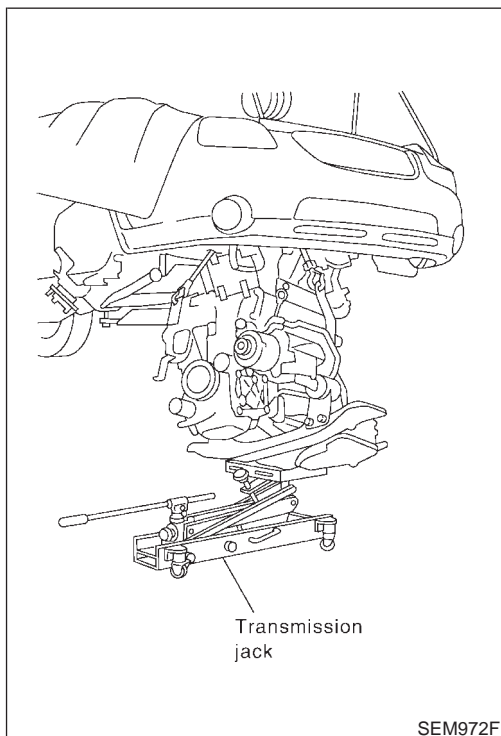
1. Remove engine undercover and hood.
2. Drain coolant from both cylinder block and radiator. Refer to MA-16, "Changing Engine Coolant".
3. Remove vacuum hoses, fuel hoses, wires, harnesses, connectors and so on.
4. Remove front exhaust tubes, ball joints and drive shafts.
5. Remove radiator and fans.
6. Remove drive belts.
7. Remove alternator, compressor and power steering oil pump from engine.
8. Set a suitable transmission jack under transaxle. Hoist engine with engine slinger.
9. Remove LH engine mounting.
10. Disconnect control rod and support rod from transaxle (M/T model).
11. Disconnect control cable from transaxle (A/T model).
12. Remove RH engine mounting.

ENGINE ASSEMBLY

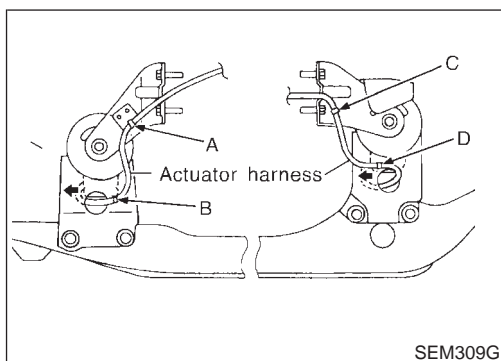
Removal and Installation (Cont'd)



13. Remove center member and then slowly lower transmission jack.



14. Remove engine with transaxle as shown.



INSTALLATION

NFEM0023S02

Installation is in the reverse order of removal. Install the electronically-controlled engine mount harness to match the following values. (Models with electronically-controlled engine mounts)

Front (A - B):
170 mm (6.69 in)

Rear (C - D):
130 mm (5.12 in)

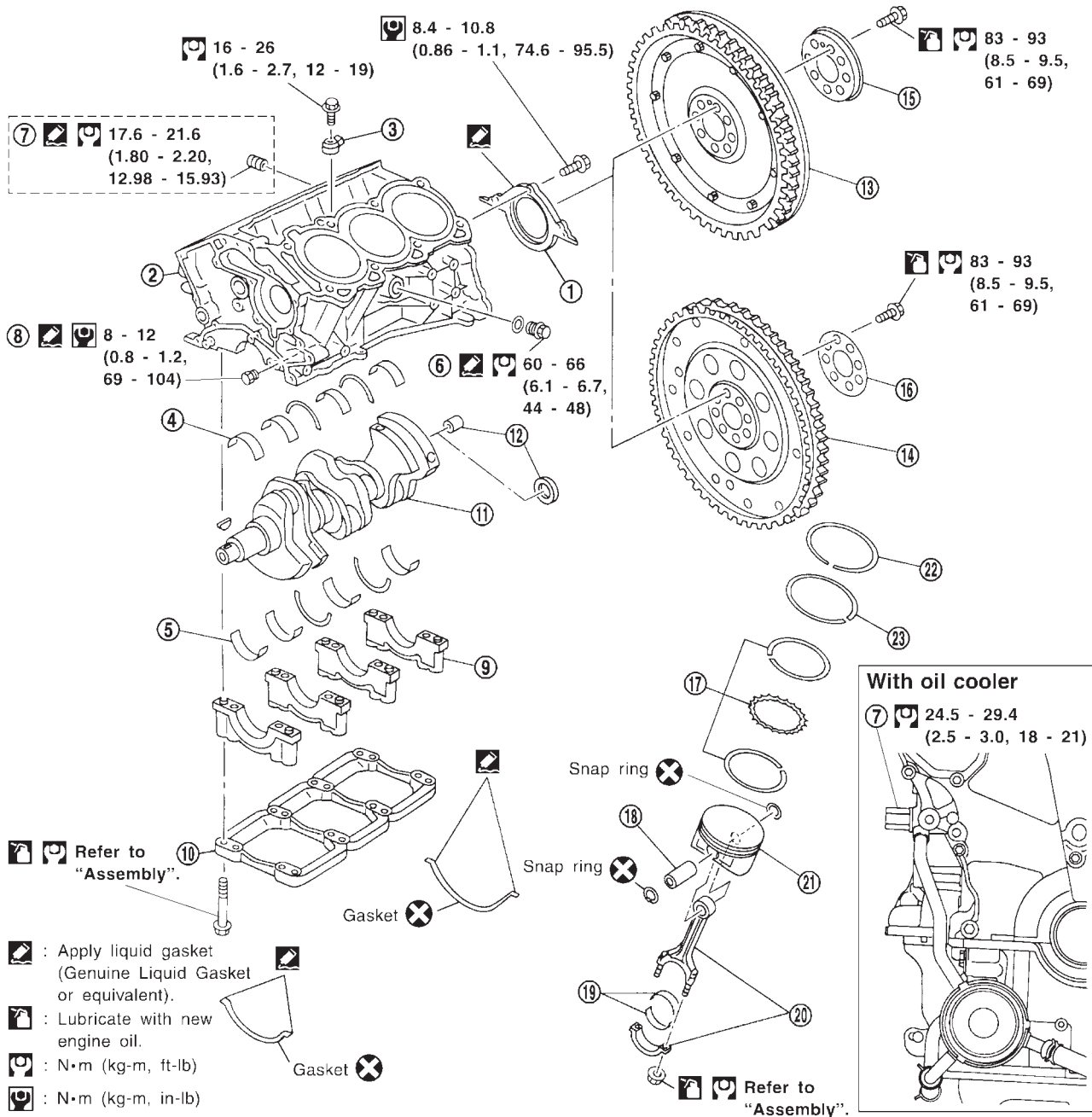
CYLINDER BLOCK

Components

NFEM0024

SEC. 110•120•226

Components

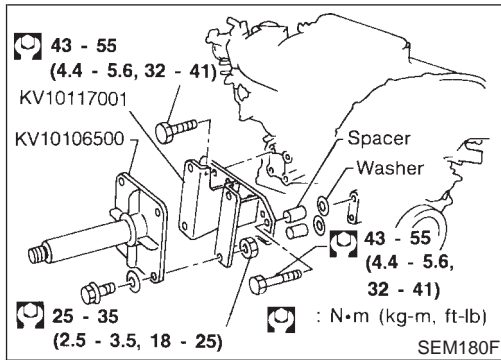


SEM527G

- | | | |
|---------------------------------------|---|-------------------------------|
| 1. Rear oil seal retainer | 9. Main bearing cap | 16. Drive plate reinforcement |
| 2. Cylinder block | 10. Main bearing beam | 17. Oil ring |
| 3. Knock sensor | 11. Crankshaft | 18. Piston pin |
| 4. Upper main bearing | 12. Pilot bushing or pilot converter | 19. Connecting rod bearing |
| 5. Lower main bearing | 13. Flywheel with signal plate (M/T models) | 20. Connecting rod |
| 6. Water drain plug (LH side) | 14. Drive plate with signal plate (A/T model) | 21. Piston |
| 7. Water drain plug (RH side) | 15. Flywheel reinforcement | 22. Top ring |
| 8. Water drain plug (Water pump side) | | 23. 2nd ring |

CYLINDER BLOCK

Removal and Installation



Removal and Installation

NFEM0025

CAUTION:

- When installing bearings, pistons, or other sliding parts, lubricate contacting surfaces with new engine oil.
- Place removed parts such as bearings and bearing caps in their proper order and direction.
- When installing connecting rod nuts, and main bearing cap bolts, apply new engine oil to threads and seating surfaces.
- Do not allow any magnetic materials to contact the signal plate teeth of flywheel or drive plate.

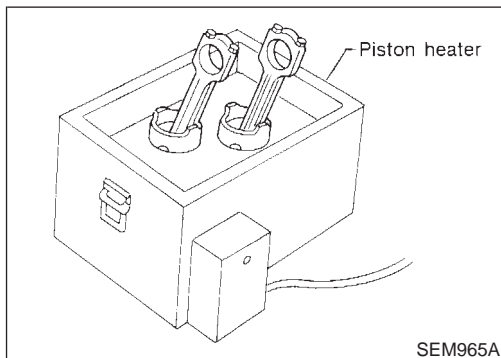
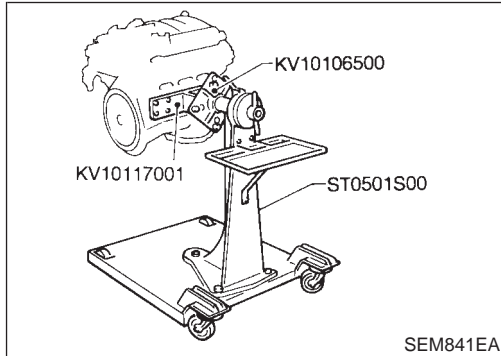
Disassembly

NFEM0026

PISTON AND CRANKSHAFT

NFEM0026S01

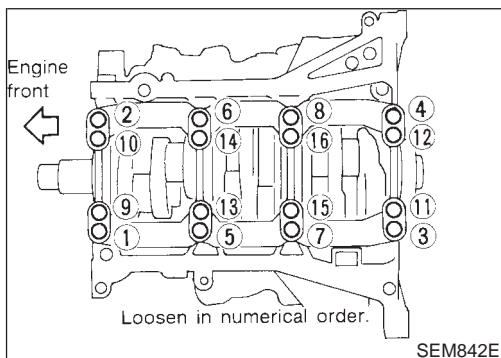
1. Remove engine. Refer to "Removal and Installation", EM-56.
2. Place engine on a work stand.
3. Drain coolant and oil.
4. Remove oil pan. Refer to "Removal", EM-12.
5. Remove timing chain. Refer to "Removal", EM-21.
6. Remove cylinder head. Refer to "Removal", EM-38.



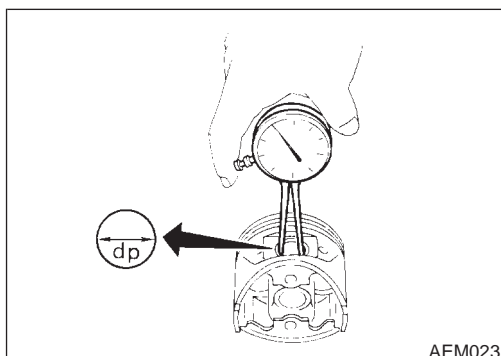
7. Remove pistons with connecting rods.
- When disassembling piston and connecting rod, remove snap ring first, then heat piston to 60 to 70°C (140 to 158°F).
8. Remove rear oil seal retainer.

CAUTION:

- When piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When replacing piston rings, if there is no punchmark, install with either side up.



9. Loosen bolts in numerical order as shown and remove main bearing beam (for VQ30DE), bearing cap and crankshaft.
- Before removing bearing beam and bearing cap, measure crankshaft end play. Refer to EM-69.
- Bolts should be loosened in two or three steps.



Inspection

NFEM0027

PISTON AND PISTON PIN CLEARANCE

NFEM0027S01

1. Measure inner diameter of piston pin hole "dp".

Standard diameter "dp":

Grade No. 0

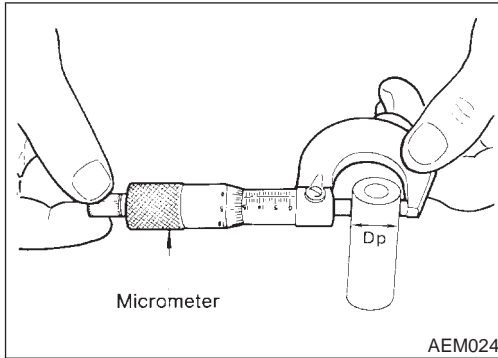
21.993 - 21.999 mm (0.8659 - 0.8661 in)

Grade No. 1

21.999 - 22.005 mm (0.8661 - 0.8663 in)

CYLINDER BLOCK

Inspection (Cont'd)



- Measure outer diameter of piston pin "Dp".

Standard diameter "Dp":

Grade No. 0

21.989 - 21.995 mm (0.8657 - 0.8659 in)

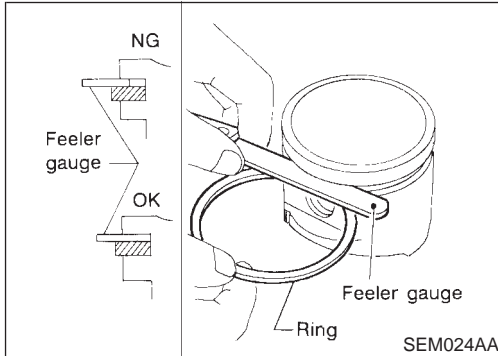
Grade No. 1

21.995 - 22.001 mm (0.8659 - 0.8662 in)

- Calculate interference fit of piston pin to piston.

Dp - dp = 0.002 - 0.006 mm (0.0001 - 0.0002 in)

If it exceeds the above value, replace piston assembly with pin.



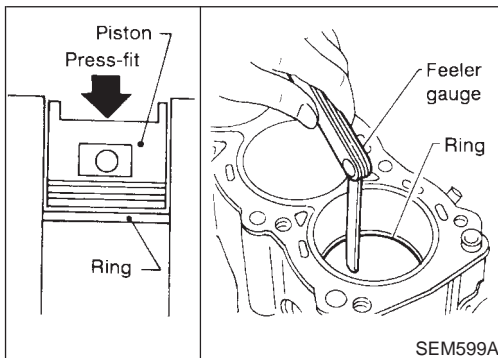
PISTON RING SIDE CLEARANCE

NFEM0027S02

Side clearance:

Ring	Engine	Standard	Limit
Top ring	VQ20DE	0.045 - 0.080 mm (0.0018 - 0.0031 in)	0.11 mm (0.0043 in)
	VQ30DE	0.040 - 0.080 mm (0.0016 - 0.0031 in)	
2nd ring	VQ20DE	0.030 - 0.070 mm (0.0012 - 0.0028 in)	0.10 mm (0.0039 in)
	VQ30DE	0.030 - 0.070 mm (0.0012 - 0.0028 in)	
Oil ring	VQ20DE	0.065 - 0.135 mm (0.0026 - 0.0053 in)	—
	VQ30DE	0.015 - 0.185 mm (0.0006 - 0.0073 in)	

If out of specification, replace piston ring. If clearance exceeds maximum limit with new ring, replace piston.



PISTON RING END GAP

NFEM0027S03

End gap:

Ring	Engine	Standard	Limit
Top ring	VQ20DE	0.18 - 0.37 mm (0.0071 - 0.0146 in)	0.51 mm (0.0201 in)
	VQ30DE	0.22 - 0.32 mm (0.0087 - 0.0126 in)	0.55 mm (0.0217 in)
2nd ring	VQ20DE	0.30 - 0.54 mm (0.0118 - 0.0213 in)	0.65 mm (0.0256 in)
	VQ30DE	0.32 - 0.47 mm (0.0126 - 0.0185 in)	0.58 mm (0.0228 in)
Oil ring (rail ring)	VQ20DE	0.20 - 0.69 mm (0.0079 - 0.0272 in)	0.95 mm (0.0374 in)
	VQ30DE	0.20 - 0.69 mm (0.0079 - 0.0272 in)	

If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, do the following. Rebore cylinder and use oversized piston and piston rings.

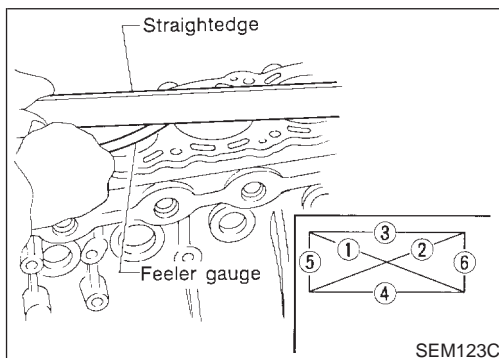
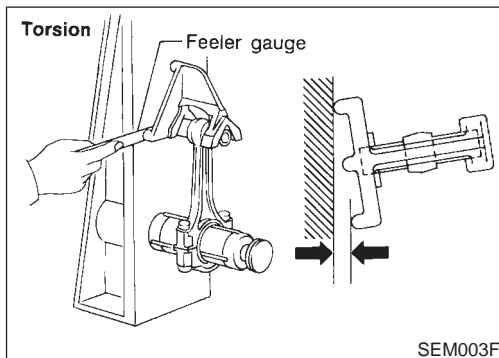
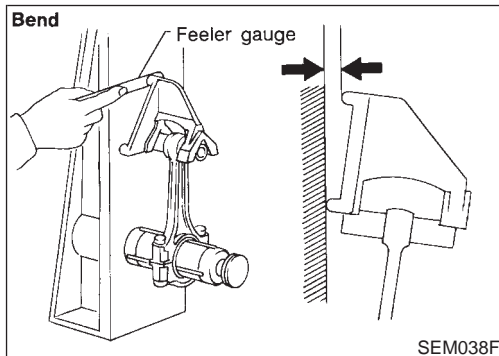
Refer to SDS (EM-82).

- When replacing the piston, check the cylinder block surface for scratches or seizure. If scratches or seizure is found, hone or

CYLINDER BLOCK

Inspection (Cont'd)

replace the cylinder block.



CONNECTING ROD BEND AND TORSION

NFEM0027S04

Bend:

Limit 0.15 mm (0.0059 in)
per 100 mm (3.94 in) length

Torsion:

Limit 0.30 mm (0.0118 in)
per 100 mm (3.94 in) length

If it exceeds the limit, replace connecting rod assembly.

CYLINDER BLOCK DISTORTION AND WEAR

NFEM0027S05

- Clean upper surface of cylinder block.
Use a reliable straightedge and feeler gauge to check the flatness of cylinder block surface.
Check along six positions shown in the figure.

Distortion limit: 0.10 mm (0.0039 in)

- If out of specification, resurface it. The limit for cylinder block resurfacing is determined by cylinder head resurfacing in engine.

Resurfacing limit:

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

The maximum limit is as follows:

$A + B = 0.2 \text{ mm (0.008 in)}$

Nominal cylinder block height from crankshaft center:

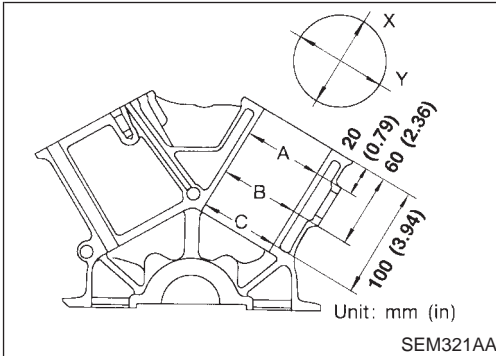
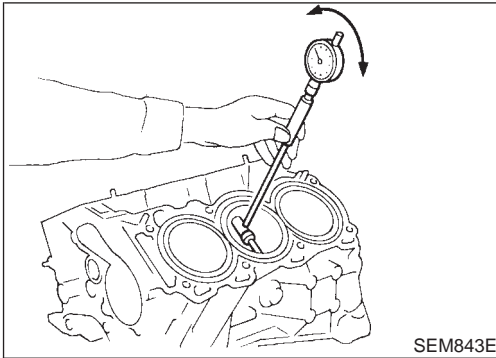
214.95 - 215.05 mm (8.4626 - 8.4665 in)

Refer to SDS (EM-80).

- If necessary, replace cylinder block.

CYLINDER BLOCK

Inspection (Cont'd)



PISTON-TO-BORE CLEARANCE

NFEM0027S06

- Using a bore gauge, measure cylinder bore for wear, out-of-round and taper.

Cylinder bore inner diameter

Grade No.	Engine	Standard inner diameter	Wear limit
No. 1	VQ20DE	76.000 - 76.010 mm (2.9921 - 2.9925 in)	0.20 mm (0.0079 in)
	VQ30DE	93.000 - 93.010 mm (3.6614 - 3.6618 in)	
No. 2	VQ20DE	76.011 - 76.020 mm (2.9926 - 2.9929 in)	
	VQ30DE	93.011 - 93.020 mm (3.6618 - 3.6622 in)	
No. 3	VQ20DE	76.021 - 76.030 mm (2.9929 - 2.9933 in)	
	VQ30DE	93.021 - 93.030 mm (3.6622 - 3.6626 in)	

If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

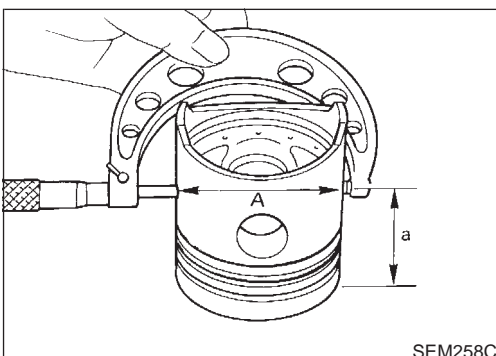
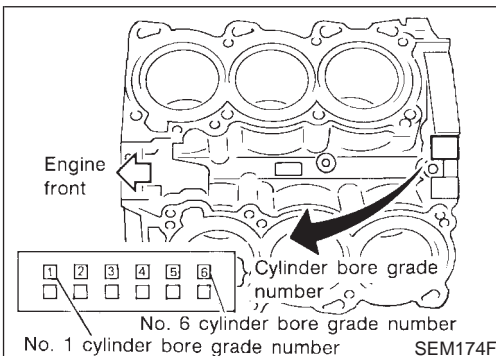
Out-of-round (X – Y):

Limit 0.015 mm (0.0006 in)

Taper (A – B – C):

Limit 0.015 mm (0.0006 in)

- Check for scratches and seizure. If seizure is found, hone it.



- If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block rear position. These numbers are punched in either Arabic or Roman numerals.

- Measure piston skirt diameter.

Piston diameter "A": Refer to SDS (EM-82).

Measuring point "a" (Distance from the top):

45.4 mm (1.787 in)

- Check that piston-to-bore clearance is within specification.

Piston-to-bore clearance "B":

VQ20DE

0.010 - 0.030 mm (0.0004 - 0.0012 in)

VQ30DE

0.010 - 0.032 mm (0.0004 - 0.0013 in)

CYLINDER BLOCK

Inspection (Cont'd)

5. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service.

Refer to SDS (EM-82).

6. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter "A".

Rebored size calculation: $D = A + B - C$

where,

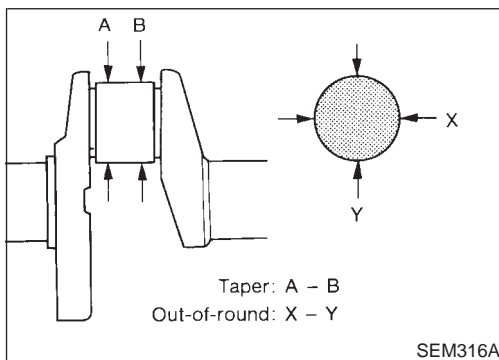
D: Bored diameter

A: Piston diameter as measured

B: Piston-to-bore clearance

C: Honing allowance 0.02 mm (0.0008 in)

7. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
8. Cut cylinder bores.
 - **When any cylinder needs boring, all other cylinders must also be bored.**
 - **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
 - **Measurement should be done after cylinder bore cools down.**



CRANKSHAFT

NFEM0027S07

1. Check crankshaft main and pin journals for score, wear or cracks.
2. With a micrometer, measure journals for taper and out-of-round.

Out-of-round (X - Y):

Standard

0.002 mm (0.0001 in)

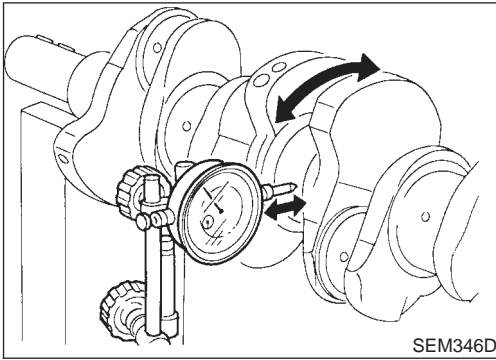
Taper (A - B):

Standard

0.002 mm (0.0001 in)

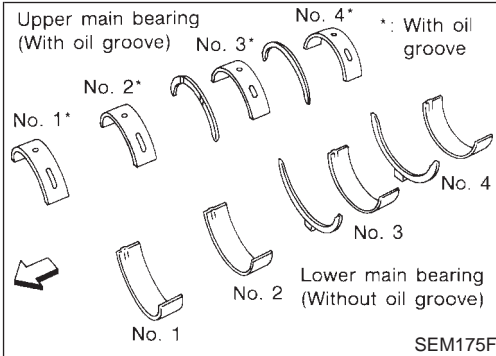
CYLINDER BLOCK

Inspection (Cont'd)



3. Measure crankshaft runout.

Runout (Total indicator reading):
Limit 0.10 mm (0.0039 in)



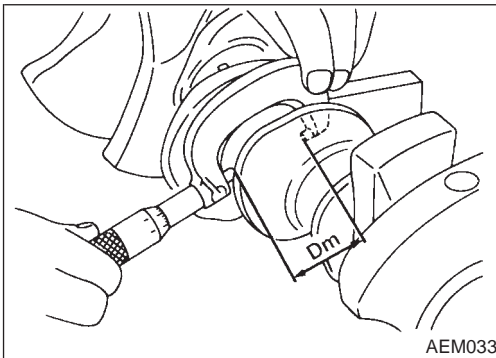
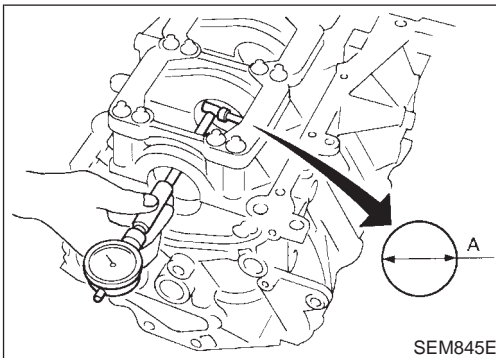
BEARING CLEARANCE

- Use either of the following two methods, however, method "A" gives more reliable results and is preferable.

Method A (Using bore gauge & micrometer)

Main bearing

1. Set main bearings in their proper positions on cylinder block and main bearing cap.
2. Install main bearing cap and bearing beam to cylinder block. **Tighten all bolts in correct order.**
3. Measure inner diameters "A" of each main bearing.



4. Measure outer diameters "Dm" of each crankshaft main journal.

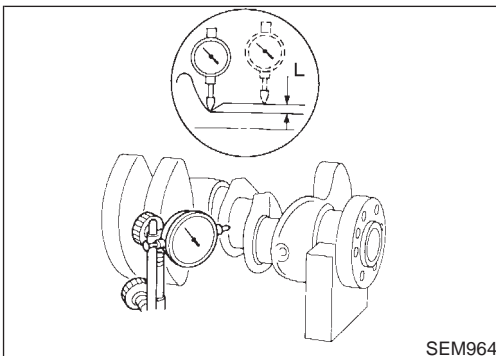
5. Calculate main bearing clearance.

Main bearing clearance = A – Dm

Standard: 0.035 - 0.045 mm (0.0014 - 0.0018 in) (Actual clearance)

Limit: 0.065 mm (0.0026 in)

- If it exceeds the limit, replace bearing.
- If clearance cannot be adjusted using any standard bearing grade, grind crankshaft journal and use undersized bearing.



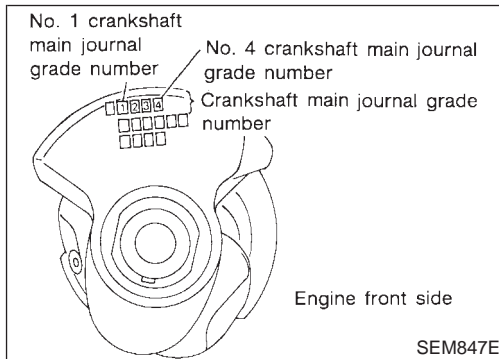
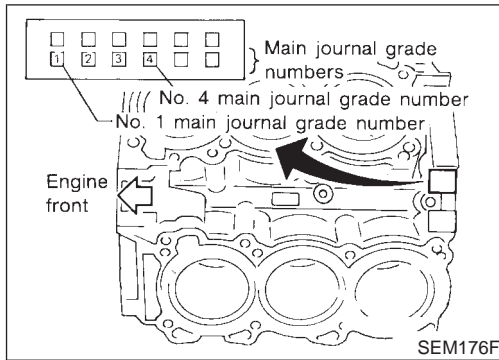
- a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.

"L": 0.1 mm (0.004 in)

- b. Refer to SDS for grinding crankshaft and available service parts.

CYLINDER BLOCK

Inspection (Cont'd)



6. If crankshaft or cylinder block is replaced with a new one, select thickness of main bearings as follows:

a. Grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Alphabet. Refer to SDS, EM-80.

If measured diameter is out of grade punched, decide suitable grade using table in SDS.

b. Grade number of each crankshaft main journal is punched on the respective crankshaft. These numbers are punched in either Arabic or Alphabet. Refer to SDS, EM-83.

If measured diameter is out of grade punched, decide suitable grade using table in SDS.

c. Select main bearing with suitable thickness according to the following table.

Refer to "SDS", EM-85, for available main bearings.

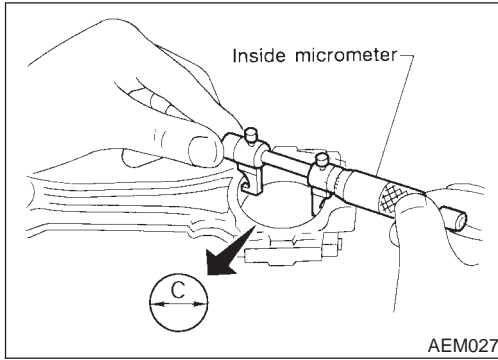
Main bearing selection table

Cylinder block main journal Crankshaft main journal		Mark	Hole diameter																											
			A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7				
Mark	Axle diameter		63.993 - 63.994	63.994 - 63.995	63.995 - 63.996	63.996 - 63.997	63.997 - 63.998	63.998 - 63.999	63.999 - 64.000	64.000 - 64.001	64.001 - 64.002	64.002 - 64.003	64.003 - 64.004	64.004 - 64.005	64.005 - 64.006	64.006 - 64.007	64.007 - 64.008	64.008 - 64.009	64.009 - 64.010	64.010 - 64.011	64.011 - 64.012	64.012 - 64.013	64.013 - 64.014	64.014 - 64.015	64.015 - 64.016	64.016 - 64.017				
A	59.975 - 59.974		0	0	0	0	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
B	59.974 - 59.973		0	0	0	1	0	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
C	59.973 - 59.972		0	0	1	0	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
D	59.972 - 59.971		0	1	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
E	59.971 - 59.970		0	1	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
F	59.970 - 59.969		0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
G	59.969 - 59.968		1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
H	59.968 - 59.967		1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
J	59.967 - 59.966		1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
K	59.966 - 59.965		1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
L	59.965 - 59.964		1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
M	59.964 - 59.963		1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
N	59.963 - 59.962		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
P	59.962 - 59.961		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
R	59.961 - 59.960		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
S	59.960 - 59.959		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
T	59.959 - 59.958		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
U	59.958 - 59.957		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4		
V	59.957 - 59.956		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5		
W	59.956 - 59.955		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5		
X	59.955 - 59.954		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5		
Y	59.954 - 59.953		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5		
4	59.953 - 59.952		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5		
7	59.952 - 59.951		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5		

SEM280G

CYLINDER BLOCK

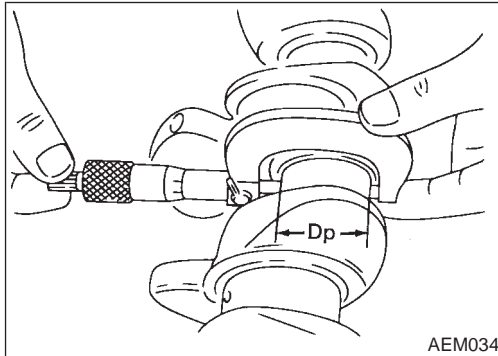
Inspection (Cont'd)



Connecting Rod Bearing (Big end)

NFEM0027S0802

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.
Tighten bolts to the specified torque.
3. Measure inner diameter "C" of connecting rod.



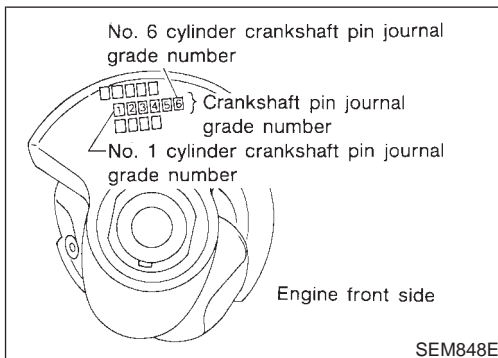
4. Measure outer diameter "Dp" of each crankshaft pin journal.
5. Calculate connecting rod bearing clearance.

Connecting rod bearing clearance = C - Dp

Standard: 0.034 - 0.059 mm (0.0013 - 0.0023 in) (Actual clearance)

Limit: 0.070 mm (0.0028 in)

6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing. Refer to "BEARING CLEARANCE — Main bearing", EM-65.



8. If crankshaft is replaced with a new one, select connecting rod bearing according to the following table.

Connecting rod bearing grade number (Identification color):

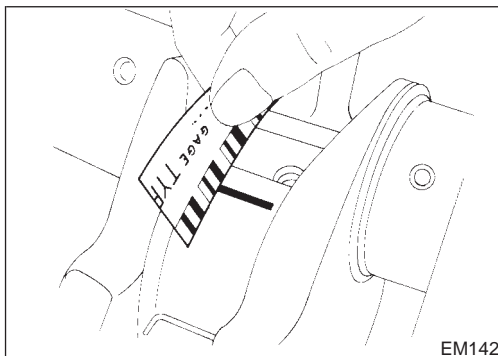
These numbers are punched in either Arabic or Roman numerals.

Crankshaft pin journal grade number	Connecting rod bearing grade number
0	0 (Black)
1	1 (Brown)
2	2 (Green)

Method B (Using plastigage)

CAUTION:

- Do not turn crankshaft or connecting rod while plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. If incorrect bearing clearance exists, use a thicker or undersized main bearing to ensure specified clearance.



CONNECTING ROD BUSHING CLEARANCE (SMALL END)

NFEM0027S09

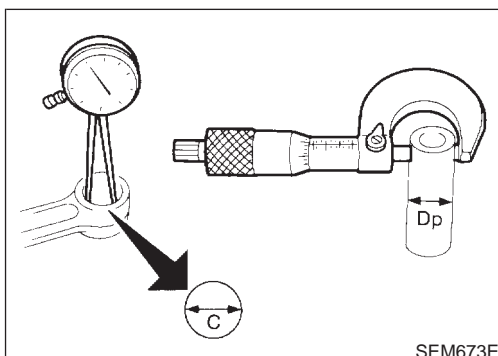
1. Measure inner diameter "C" of bushing.
2. Measure outer diameter "Dp" of piston pin.
3. Calculate connecting rod bushing clearance.

Connecting rod bushing clearance = C - Dp

Standard: 0.005 - 0.017 mm (0.0002 - 0.0007 in)

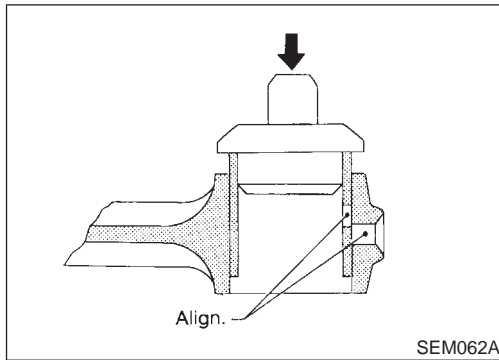
Limit: 0.030 mm (0.0012 in)

If it exceeds the limit, replace connecting rod assembly or connecting rod bushing and/or piston set with pin.



CYLINDER BLOCK

Inspection (Cont'd)



REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END)

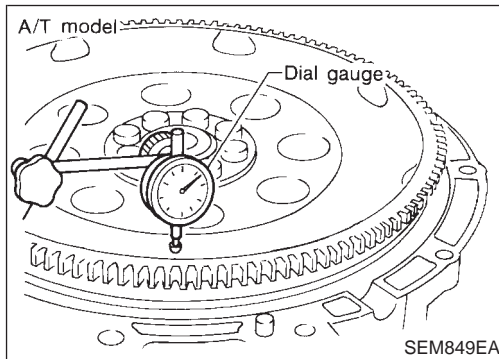
NFEM0027S10

1. Drive in small end bushing until it is flush with end surface of rod.

Be sure to align the oil holes.

2. After driving in small end bushing, ream the bushing. This is to ensure the clearance between connecting rod bushing and piston pin is the specified value.

Clearance between connecting rod bushing and piston pin: 0.005 - 0.017 mm (0.0002 - 0.0007 in)



FLYWHEEL/DRIVE PLATE RUNOUT

NFEM0027S11

Runout (Total indicator reading):

Flywheel (M/T model)★

Less than 0.15 mm (0.0059 in)

Drive plate (A/T model)

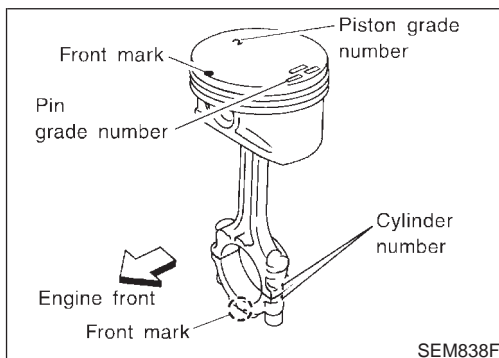
Less than 0.15 mm (0.0059 in)

★ Measurement position:

Approximately 145 mm (5.71 in) from the crankshaft center

CAUTION:

- The signal plate is built into the flywheel assembly. Be careful not to damage the signal plate, especially the teeth.
- Check the drive plate and signal plate for deformation or cracks.
- Never place the flywheel assembly with the signal plate facing down.
- Keep any magnetized objects away from the signal plate.
- Do not allow any magnetic materials to contact the signal plate teeth.
- Do not surface flywheel. Replace as necessary.



Assembly

NFEM0028

PISTON

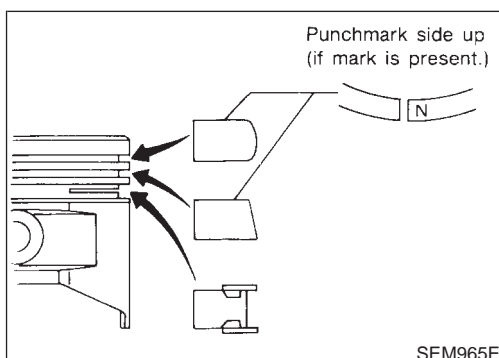
NFEM0028S01

1. Install new snap ring on one side of piston pin hole.
2. Heat piston to 60 to 70°C (140 to 158°F) and assemble piston, piston pin, connecting rod and new snap ring.
 - **Align the direction of piston and connecting rod.**
 - **Numbers stamped on connecting rod and cap correspond to each cylinder.**
 - **After assembly, make sure connecting rod swings smoothly.**

3. Set piston rings as shown.

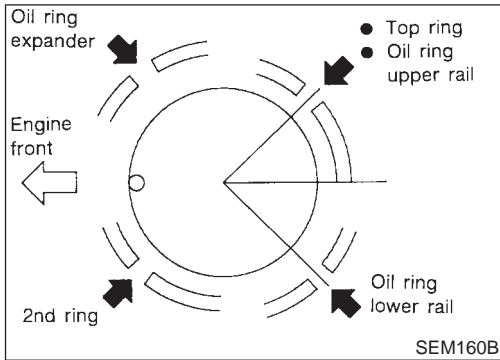
CAUTION:

- **When piston rings are not replaced, make sure that piston rings are mounted in their original positions.**
- **When replacing piston rings, these without punchmarks, present, piston rings can be mounted with either side up.**

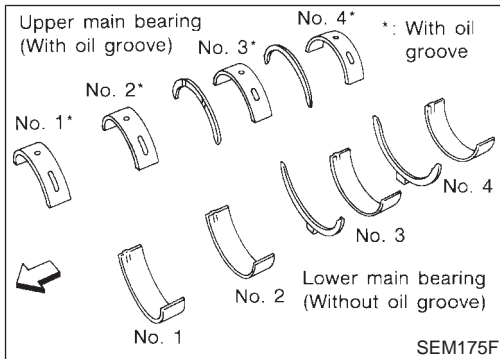


CYLINDER BLOCK

Assembly (Cont'd)



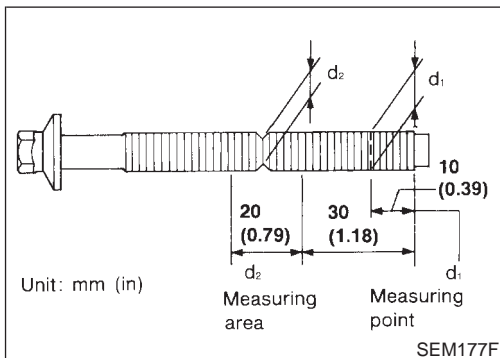
- Align piston rings so that end gaps are positioned as shown in the figure.



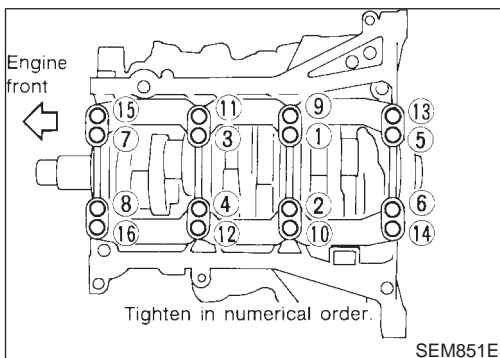
CRANKSHAFT

NFEM0028S02

- Set main bearings in their proper positions on cylinder block and main bearing beam.
- Confirm that correct main bearings are used. Refer to "Inspection" of this section.



- Instructions for re-use of main bearing cap bolts.
- A plastic zone tightening method is used for tightening main bearing cap bolts. Measure d1 and d2 as shown in the figure.
d2: Select minimum diameter in the measuring area.
If the difference between d1 and d2 exceeds the limit, replace the bolts with new ones.
Limit (d1 - d2): 0.11 mm (0.0043 in)



- After installing crankshaft, main bearing cap, main bearing beam (for VQ30DE) and bearing cap bolts, tighten bearing cap bolts in numerical order as shown.

- Tightening procedure**
 - Tighten all bolts to 32 to 38 N·m (3.3 to 3.9 kg·m, 24 to 28 ft·lb).
 - Turn all bolts 90 to 95 degrees clockwise with angle wrench.
- Prior to tightening bearing cap bolts, place bearing beam in its proper position by shifting crankshaft in the axial direction.
- After securing bearing cap bolts, make sure crankshaft turns smoothly by hand.
- Lubricate threads and seat surfaces of the bolts with new engine oil.

- Measure crankshaft end play.

Crankshaft end play:

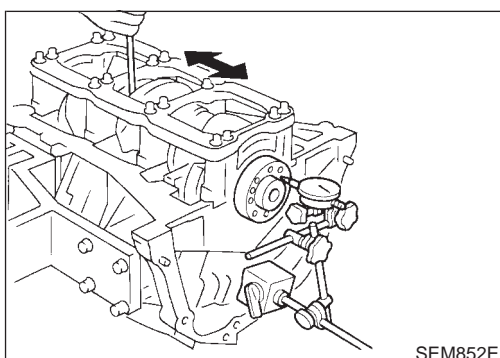
Standard

0.10 - 0.25 mm (0.0039 - 0.0098 in)

Limit

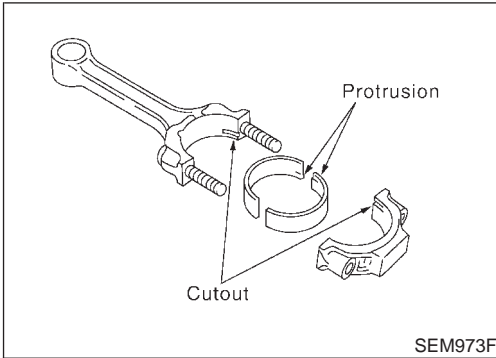
0.30 mm (0.0118 in)

If beyond the limit, replace bearing with a new one.

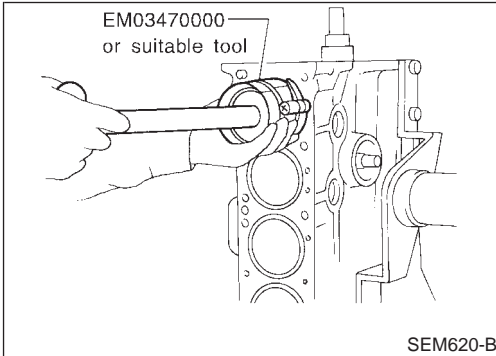


CYLINDER BLOCK

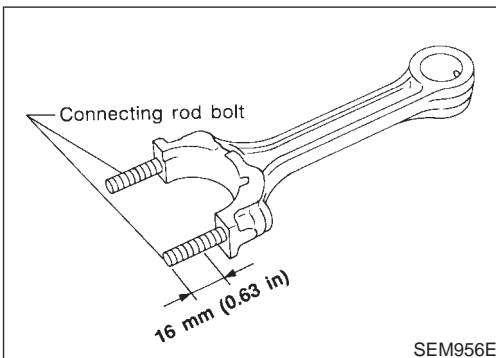
Assembly (Cont'd)



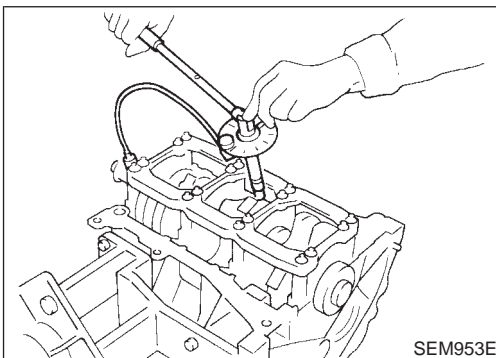
5. Install connecting rod bearings in connecting rods and connecting rod caps.
 - **Confirm that correct bearings are used.**



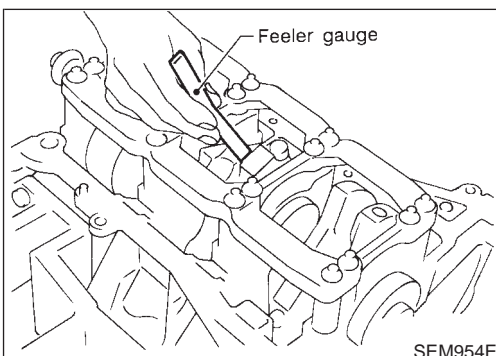
6. Install pistons with connecting rods.
 - a. Install them into corresponding cylinders with Tool.
 - **Be careful not to scratch cylinder wall with the connecting rod.**
 - **Arrange so that front mark on piston head faces toward engine front.**



- b. A plastic zone tightening method is used for tightening connecting rod bolts and nuts. Check the old bolts for deformation before re-using them.
 - **Ensure that the connecting rod nut can be screwed smoothly as far as the bolt thread end.**
 - **If this is not possible, use slide calipers to measure the outside diameter of the narrowest thread part of the bolt at 16 mm (0.63 in) from the thread end. Replace the connecting rod bolt and nut, if under the limit.**
 - Standard: 7.90 - 8.00 mm (0.3110 - 0.3150 in)**
 - Limit: 7.75 mm (0.3051 in)**



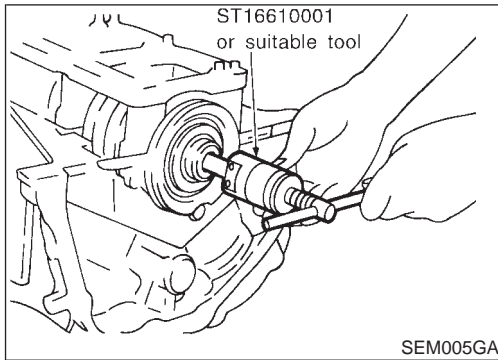
- c. Install connecting rod caps.
 - **Lubricate threads and seat surfaces with new engine oil.** Tighten connecting rod bearing cap nuts to the specified torque.
 - Connecting rod bearing nut:**
 - (1) Tighten nuts to 19 to 21 N·m (1.9 to 2.1 kg-m, 14 to 15 ft-lb).**
 - (2) Turn nuts 90 to 95 degrees clockwise with angle wrench.**



7. Measure connecting rod side clearance.
 - Connecting rod side clearance:**
 - Standard**
 - 0.20 - 0.35 mm (0.0079 - 0.0138 in)**
 - Limit**
 - 0.40 mm (0.0157 in)**
 - If beyond the limit, replace connecting rod and/or crankshaft.
8. Install rear oil seal retainer.

CYLINDER BLOCK

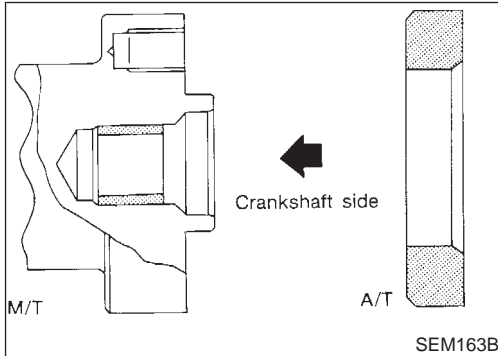
Assembly (Cont'd)



REPLACEMENT OF PILOT BUSHING (M/T) OR PILOT CONVERTER (A/T)

NFEM0028S04

1. Remove pilot bushing or pilot converter using tool or suitable tool.



2. Install pilot bushing or pilot converter as shown.

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specifications

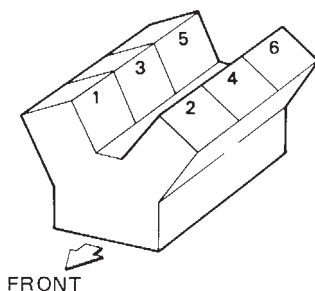
General Specifications				NFEM0029
Engine		VQ20DE		VQ30DE
Cylinder arrangement		V-6		
Displacement cm ³ (cu in)		1,995 (121.73)		2,988 (182.33)
Bore and stroke mm (in)		76.0 × 73.3 (2.992 × 2.886)		93 × 73.3 (3.66 × 2.886)
Valve arrangement		DOHC		
Firing order		1-2-3-4-5-6		
Number of piston rings	Compression		2	
	Oil		1	
Number of main bearings		4		
Compression ratio		9.5		10.0

Compression Pressure

Unit: kPa (bar, kg/cm², psi)/300 rpm NFEM0030

Compression pressure	Standard	1,275 (12.75, 13.0, 185)
	Minimum	981 (9.81, 10.0, 142)
	Differential limit between cylinders	98 (0.98, 1.0, 14)

Cylinder number



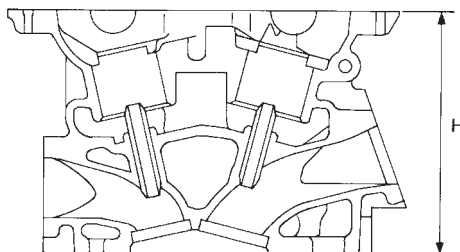
FRONT

SEM713A

Cylinder Head

Unit: mm (in) NFEM0031

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)



Nominal cylinder head height:
H = 126.3 - 126.5 mm (4.972 - 4.980 in)

SEM949E

SERVICE DATA AND SPECIFICATIONS (SDS)

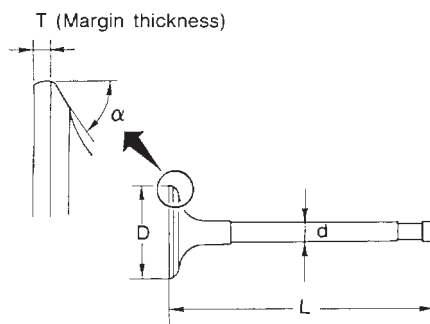
Valve

Valve

VALVE

NFEM0032

NFEM0032S01
Unit: mm (in)



SEM188

Engine		VQ20DE	VQ30DE
Valve head diameter "D"	Intake	29.0 - 29.3 (1.142 - 1.154)	36.0 - 36.3 (1.417 - 1.429)
	Exhaust	23.9 - 24.2 (0.941 - 0.953)	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	99.44 - 99.94 (3.9150 - 3.9346)	97.32 - 97.82 (3.8315 - 3.8512)
	Exhaust	96.97 - 97.47 (3.8177 - 3.8374)	94.85 - 95.35 (3.7342 - 3.7539)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)	
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)	
Valve seat angle "α"	Intake	45°15' - 45°45'	
	Exhaust		
Valve margin "T"	Intake	0.95 - 1.25 (0.0374 - 0.0492)	
	Exhaust	1.15 - 1.45 (0.0453 - 0.0571)	
Valve margin "T" limit		More than 0.5 (0.020)	
Valve stem end surface grinding limit		Less than 0.2 (0.008)	
Valve clearance (Cold)	Intake	0.26 - 0.34 (0.010 - 0.013)	
	Exhaust	0.29 - 0.37 (0.011 - 0.015)	

VALVE CLEARANCE

NFEM0032S02
Unit: mm (in)

	Cold	Hot* (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve (Cont'd)

AVAILABLE SHIMS

=NFEM0032S03

Engine	VQ20DE	VQ30DE
ID mark	Thickness mm (in)	
210	2.10 (0.0827)	—
212	2.12 (0.0835)	—
214	2.14 (0.0843)	—
216	2.16 (0.0850)	—
218	2.18 (0.0858)	—
220	2.20 (0.0866)	—
221	2.21 (0.0870)	—
222	2.22 (0.0874)	—
223	2.23 (0.0878)	—
224	2.24 (0.0882)	—
225	2.25 (0.0886)	—
226	2.26 (0.0890)	—
227	2.27 (0.0894)	—
228	2.28 (0.0898)	—
229	2.29 (0.0902)	—
230	2.30 (0.0906)	—
231	2.31 (0.0909)	—
232	2.32 (0.0913)	
233	2.33 (0.0917)	
234	2.34 (0.0921)	
235	2.35 (0.0925)	
236	2.36 (0.0929)	
237	2.37 (0.0933)	
238	2.38 (0.0937)	
239	2.39 (0.0941)	
240	2.40 (0.0945)	
241	2.41 (0.0949)	
242	2.42 (0.0953)	
243	2.43 (0.0957)	
244	2.44 (0.0961)	
245	2.45 (0.0965)	
246	2.46 (0.0969)	
247	2.47 (0.0972)	
248	2.48 (0.0976)	
249	2.49 (0.0980)	
250	2.50 (0.0984)	
251	2.51 (0.0988)	
252	2.52 (0.0992)	

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve (Cont'd)

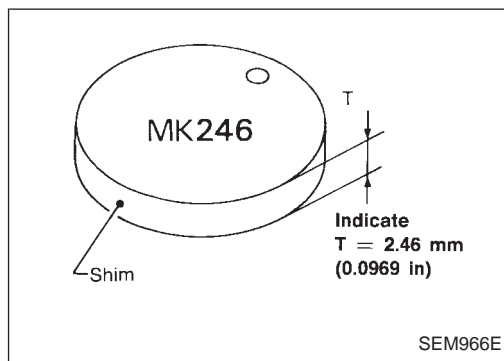
Engine	VQ20DE	VQ30DE
ID mark	Thickness mm (in)	
253	2.53 (0.0996)	
254	2.54 (0.1000)	
255	2.55 (0.1004)	
256	2.56 (0.1008)	
257	2.57 (0.1012)	
258	2.58 (0.1016)	
259	2.59 (0.1020)	
260	2.60 (0.1024)	
261	2.61 (0.1028)	
262	2.62 (0.1031)	
263	2.63 (0.1035)	
264	2.64 (0.1039)	
265	2.65 (0.1043)	
266	2.66 (0.1047)	
267	—	2.67 (0.1051)
268	2.68 (0.1055)	
269	—	2.69 (0.1059)
270	2.70 (0.1063)	
271	—	2.71 (0.1067)
272	2.72 (0.1071)	
273	—	2.73 (0.1075)
274	—	2.74 (0.1079)
275	—	2.75 (0.1083)
276	—	2.76 (0.1087)
277	—	2.77 (0.1091)
278	—	2.78 (0.1094)
279	—	2.79 (0.1098)
280	—	2.80 (0.1102)
281	—	2.81 (0.1106)
282	—	2.82 (0.1110)
283	—	2.83 (0.1114)
284	—	2.84 (0.1118)
285	—	2.85 (0.1122)
286	—	2.86 (0.1126)
287	—	2.87 (0.1130)
288	—	2.88 (0.1134)
289	—	2.89 (0.1138)
290	—	2.90 (0.1142)
291	—	2.91 (0.1146)

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve (Cont'd)

Engine	VQ20DE	VQ30DE
ID mark	Thickness mm (in)	
292	—	2.92 (0.1150)
293	—	2.93 (0.1154)
294	—	2.94 (0.1157)
295	—	2.95 (0.1161)

—: Not available



VALVE SPRING

NFEM0032S04

Engine	VQ20DE	VQ30DE
Free height mm (in)	53.14 (2.0921)	47.10 (1.8543)
Pressure N (kg, lb) at height mm (in)	Standard	167 (17, 37) at 37.0 (1.457)
	Limit	202 (20.6, 45.4) at 37.0 (1.457)
Out-of-square mm (in)	Less than 2.3 (0.091)	Less than 2.1 (0.083)

VALVE LIFTER

NFEM0032S05
Unit: mm (in)

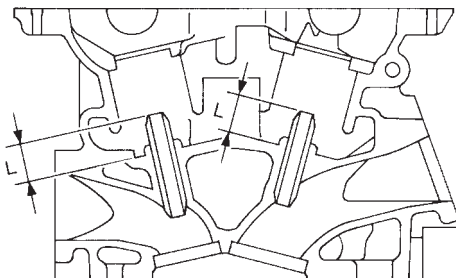
Engine	VQ20DE	VQ30DE
Valve lifter outer diameter	29.965 - 29.975 (1.1797 - 1.1801)	34.960 - 34.975 (1.3764 - 1.3770)
Lifter guide inner diameter	IN	30.015 - 30.036 (1.1817 - 1.1825)
	EX	30.003 - 30.024 (1.1812 - 1.1820)
Clearance between lifter and lifter guide	IN	0.040 - 0.071 (0.0016 - 0.0028)
	EX	0.028 - 0.059 (0.0011 - 0.0023)

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve (Cont'd)

VALVE GUIDE

=NFEM0032S06
Unit: mm (in)



SEM950E

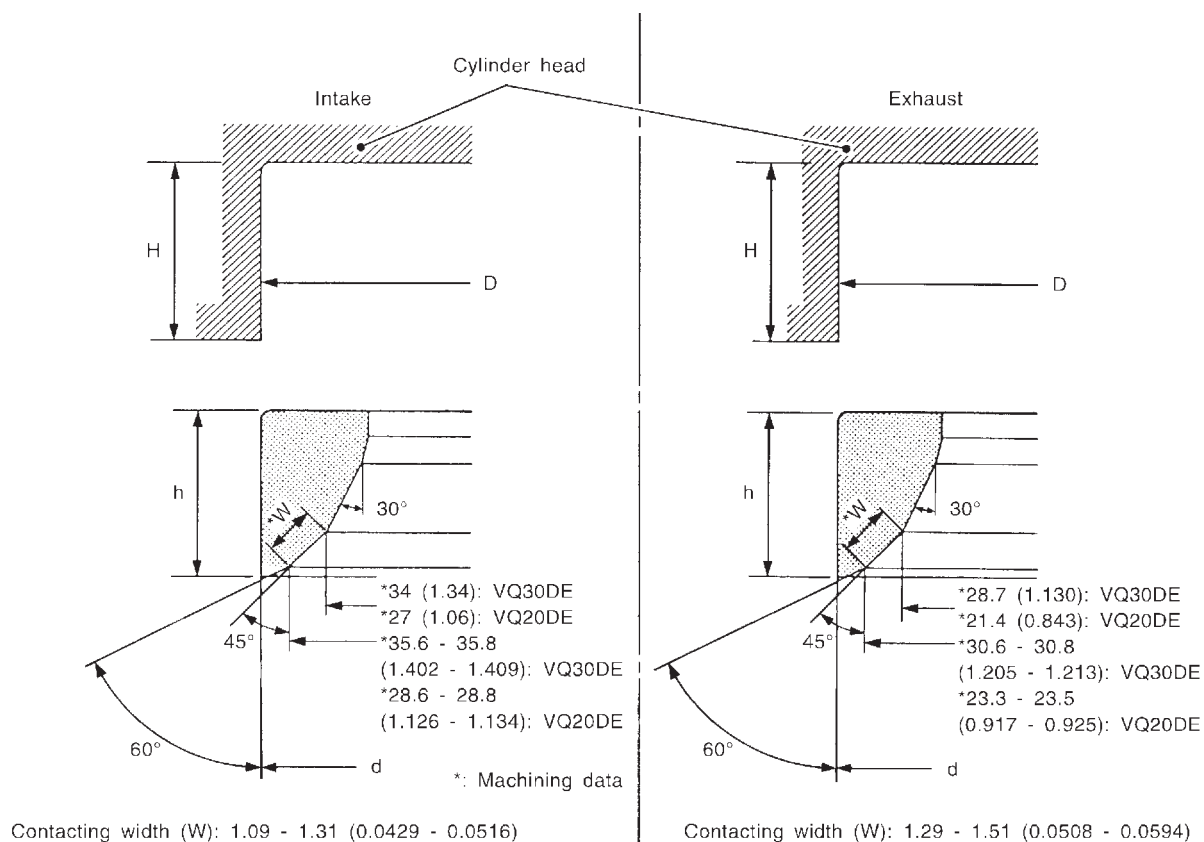
		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Max. tolerance
Stem to guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)
Valve deflection limit	Intake	—	0.24 (0.0094)
	Exhaust	—	0.28 (0.0110)
Projection length "L"		12.6 - 12.8 (0.496 - 0.504)	

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Seat

Valve Seat

=NFEM0033
Unit: mm (in)



SEM179F

VQ20DE

NFEM0033S03
Unit: mm (in)

		Standard	Service
Cylinder head seat recess diameter (D)	In.	30.000 - 30.016 (1.1811 - 1.1817)	30.500 - 30.516 (1.2008 - 1.2014)
	Ex.	25.000 - 25.016 (0.9843 - 0.9849)	25.500 - 25.516 (1.004 - 1.0046)
Valve seat interference fit	In.	0.064 - 0.096 (0.0025 - 0.0038)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	In.	30.080 - 30.096 (1.1842 - 1.1849)	30.580 - 30.596 (1.2039 - 1.2046)
	Ex.	25.080 - 25.096 (0.9874 - 0.9880)	25.580 - 25.596 (1.0071 - 1.0077)
Height (h)	In.	6.2 - 6.3 (0.244 - 0.248)	5.55 - 5.65 (0.2185 - 0.2224)
	Ex.	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)		5.9 - 6.1 (0.232 - 0.240)	

VQ30DE

NFEM0033S04
Unit: mm (in)

		Standard	Service
Cylinder head seat recess diameter (D)	In.	37.000 - 37.016 (1.4567 - 1.4573)	37.500 - 37.516 (1.4764 - 1.4770)
	Ex.	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)

SERVICE DATA AND SPECIFICATIONS (SDS)

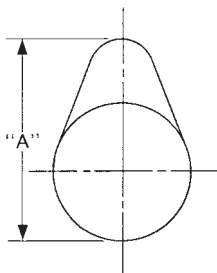
Valve Seat (Cont'd)

		Standard	Service
Valve seat interference fit	In.	0.081 - 0.113 (0.0032 - 0.0044)	
	Ex.	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	In.	37.097 - 37.113 (1.4605 - 1.4611)	37.597 - 37.613 (1.4802 - 1.4808)
	Ex.	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Height (h)	In.	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Ex.	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)		5.9 - 6.1 (0.232 - 0.240)	

Camshaft and Camshaft Bearing

NFEM0034
Unit: mm (in)

	Standard	Limit
Camshaft journal to bearing clearance	No. 1 0.045 - 0.086 (0.0018 - 0.0034) No. 2, 3, 4 0.035 - 0.076 (0.0014 - 0.0030)	0.15 (0.0059)
Inner diameter of camshaft bearing	No. 1 26.000 - 26.021 (1.0236 - 1.0244) No. 2, 3, 4 23.500 - 23.521 (0.9252 - 0.9260)	—
Outer diameter of camshaft journal	No. 1 25.935 - 25.955 (1.0211 - 1.0218) No. 2, 3, 4 23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft runout [TIR*]	Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]	Less than 0.15 (0.0059)	—
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)



EM671

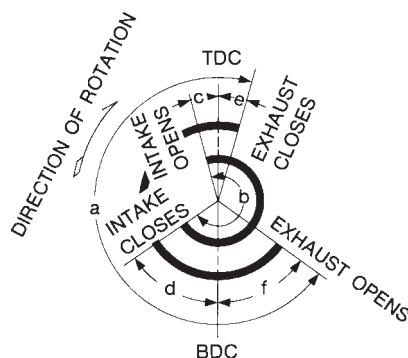
Engine		VQ20DE	VQ30DE
Cam height "A"	Intake	43.355 - 43.545 (1.7069 - 1.7144)	43.940 - 44.130 (1.7299 - 1.7374)
	Exhaust	43.405 - 43.595 (1.7089 - 1.7163)	44.465 - 44.655 (1.7506 - 1.7581)
Wear limit of cam height		0.2 (0.008)	

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

Camshaft and Camshaft Bearing (Cont'd)

Valve timing



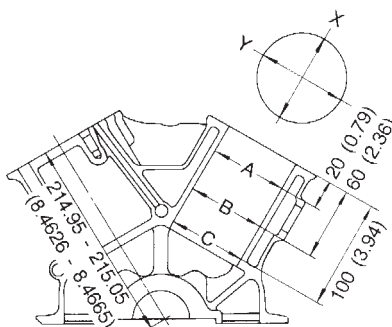
EM120

Unit: degree

	a	b	c	d	e	f
VQ20DE	232	224	3	41	3	49
VQ30DE	232	224	3	41	3	49

Cylinder Block

NFEM0035
Unit: mm (in)



SEM022EA

		VQ20DE	VQ30DE	Limit
		Standard		
Surface flatness		Less than 0.03 (0.0012)		0.1 (0.004)
Cylinder bore inner diameter	Grade No. 1	76.000 - 76.010 (2.9921 - 2.9925)	93.000 - 93.010 (3.6614 - 3.6618)	0.20 (0.0079)
	Grade No. 2	76.011 - 76.020 (2.9926 - 2.9929)	93.011 - 93.020 (3.6618 - 3.6622)	
	Grade No. 3	76.021 - 76.030 (2.9929 - 2.9933)	93.021 - 93.030 (3.6622 - 3.6626)	
Out-of-round (X – Y)		Less than 0.015 (0.0006)		—
Taper (A – B – C)		Less than 0.015 (0.0006)		—

SERVICE DATA AND SPECIFICATIONS (SDS)

Cylinder Block (Cont'd)

Main journal inner diameter	Grade No. A	63.993 - 63.994 (2.5194 - 2.5194)	—
	Grade No. B	63.994 - 63.995 (2.5194 - 2.5195)	
	Grade No. C	63.995 - 63.996 (2.5195 - 2.5195)	
	Grade No. D	63.996 - 63.997 (2.5195 - 2.5196)	
	Grade No. E	63.997 - 63.998 (2.5196 - 2.5196)	
	Grade No. F	63.998 - 63.999 (2.5196 - 2.5196)	
	Grade No. G	63.999 - 64.000 (2.5196 - 2.5197)	
	Grade No. H	64.000 - 64.001 (2.5197 - 2.5197)	
	Grade No. J	64.001 - 64.002 (2.5197 - 2.5198)	
	Grade No. K	64.002 - 64.003 (2.5198 - 2.5198)	
	Grade No. L	64.003 - 64.004 (2.5198 - 2.5198)	
	Grade No. M	64.004 - 64.005 (2.5198 - 2.5199)	
	Grade No. N	64.005 - 64.006 (2.5199 - 2.5199)	
	Grade No. P	64.006 - 64.007 (2.5199 - 2.5200)	
	Grade No. R	64.007 - 64.008 (2.5200 - 2.5200)	
	Grade No. S	64.008 - 64.009 (2.5200 - 2.5200)	
	Grade No. T	64.009 - 64.010 (2.5200 - 2.5201)	
	Grade No. U	64.010 - 64.011 (2.5201 - 2.5201)	
	Grade No. V	64.011 - 64.012 (2.5201 - 2.5202)	
	Grade No. W	64.012 - 64.013 (2.5202 - 2.5202)	
	Grade No. X	64.013 - 64.014 (2.5202 - 2.5202)	
	Grade No. Y	64.014 - 64.015 (2.5202 - 2.5203)	
	Grade No. 4	64.015 - 64.016 (2.5203 - 2.5203)	
	Grade No. 7	64.016 - 64.017 (2.5203 - 2.5203)	
Difference in inner diameter between cylinders		Less than 0.03 (0.0012)	—

SERVICE DATA AND SPECIFICATIONS (SDS)

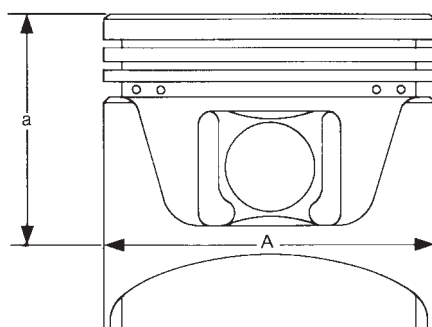
Piston, Piston Ring and Piston Pin

Piston, Piston Ring and Piston Pin

=NFEM0036

AVAILABLE PISTON

NFEM0036S01
Unit: mm (in)



SEM882E

Engine			VQ20DE	VQ30DE
Piston skirt diameter “A”	Standard	Grade No. 1	75.980 - 75.990 (2.9913 - 2.9917)	92.979 - 92.988 (3.6606 - 3.6609)
		Grade No. 2	75.990 - 76.000 (2.9917 - 2.9921)	92.988 - 93.000 (3.6609 - 3.6614)
		Grade No. 3	76.000 - 76.010 (2.9921 - 2.9925)	93.000 - 93.009 (3.6614 - 3.6618)
		0.20 (0.0079) oversize (Service)	76.180 - 76.210 (2.992 - 3.0004)	93.179 - 93.209 (3.6685 - 3.6696)
“a” dimension			45.4 (1.787)	
Piston pin hole diameter		Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	
		Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	
Piston clearance to cylinder block			0.010 - 0.030 (0.0004 - 0.0012)	0.010 - 0.032 (0.0004 - 0.0013)

PISTON RING

NFEM0036S02
Unit: mm (in)

		Standard		Limit	
Engine		VQ20DE	VQ30DE	VQ20DE	VQ30DE
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)	
	2nd	0.030 - 0.070 (0.0012 - 0.0028)		0.10 (0.0039)	
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	0.015 - 0.185 (0.0006 - 0.0073)	—	
End gap	Top	0.18 - 0.37 (0.0071 - 0.0146)	0.22 - 0.32 (0.0087 - 0.0126)	0.51 (0.0201)	0.55 (0.0217)
	2nd	0.30 - 0.54 (0.0118 - 0.0213)	0.32 - 0.47 (0.0126 - 0.0185)	0.65 (0.0256)	0.58 (0.0228)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)		0.95 (0.0374)	

PISTON PIN

NFEM0036S03
Unit: mm (in)

Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)
	Limit	0.030 (0.0012)

*: Values measured at ambient temperature of 20°C (68°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

Connecting Rod

Connecting Rod

NFEM0037
Unit: mm (in)

Center distance		147.60 - 147.70 (5.8110 - 5.8149)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - 0.9449)
Piston pin bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end inner diameter		48.000 - 48.013 (1.8898 - 1.8903)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

*: After installing in connecting rod

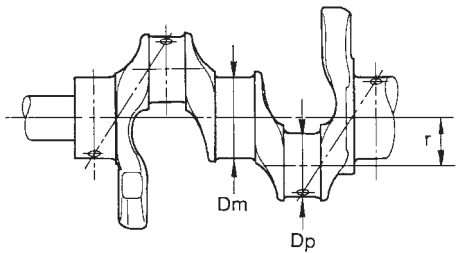
Crankshaft

NFEM0038
Unit: mm (in)

Main journal dia. "Dm" grade	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
	Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
	Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
	Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
	Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
	Grade No. F	59.970 - 59.969 (2.3610 - 2.3610)
	Grade No. G	59.969 - 59.968 (2.3610 - 2.3609)
	Grade No. H	59.968 - 59.967 (2.3609 - 2.3609)
	Grade No. J	59.967 - 59.966 (2.3609 - 2.3609)
	Grade No. K	59.966 - 59.965 (2.3609 - 2.3608)
	Grade No. L	59.965 - 59.964 (2.3608 - 2.3608)
	Grade No. M	59.964 - 59.963 (2.3608 - 2.3607)
	Grade No. N	59.963 - 59.962 (2.3607 - 2.3607)
	Grade No. P	59.962 - 59.961 (2.3607 - 2.3607)
	Grade No. R	59.961 - 59.960 (2.3607 - 2.3606)
	Grade No. S	59.960 - 59.959 (2.3606 - 2.3606)
	Grade No. T	59.959 - 59.958 (2.3606 - 2.3605)
	Grade No. U	59.958 - 59.957 (2.3605 - 2.3605)
	Grade No. V	59.957 - 59.956 (2.3605 - 2.3605)
	Grade No. W	59.956 - 59.955 (2.3605 - 2.3604)
	Grade No. X	59.955 - 59.954 (2.3604 - 2.3604)
	Grade No. Y	59.954 - 59.953 (2.3604 - 2.3603)
	Grade No. 4	59.953 - 59.952 (2.3603 - 2.3603)
	Grade No. 7	59.952 - 59.951 (2.3603 - 2.3603)
Pin journal dia. "Dp"	Grade No. 0	44.968 - 44.974 (1.7704 - 1.7706)
	Grade No. 1	44.962 - 44.968 (1.7702 - 1.7704)
	Grade No. 2	44.956 - 44.962 (1.7699 - 1.7702)
Center distance "r"		36.61 - 36.69 (1.4413 - 1.4445)
Out-of-round (X - Y)	Standard	Less than 0.002 (0.0001)
Taper (A - B)	Standard	Less than 0.002 (0.0001)
Runout [TIR]	Limit	Less than 0.10 (0.0039)
Free end play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)

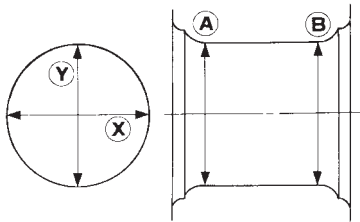
SERVICE DATA AND SPECIFICATIONS (SDS)

Crankshaft (Cont'd)



SEM645

Out-of-round (X) - (Y)
Taper (A) - (B)



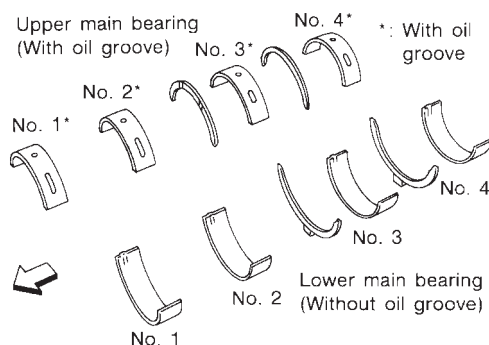
EM715

SERVICE DATA AND SPECIFICATIONS (SDS)

Available Main Bearing

Available Main Bearing

=NFEM0039



SEM175F

Grade number		Thickness “T” mm (in)	Width “W” mm (in)	Identification color (UPR/LWR)	Remarks	
0		2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.	
1		2.003 - 2.006 (0.0789 - 0.0790)		Brown		
2		2.006 - 2.009 (0.0790 - 0.0791)		Green		
3		2.009 - 2.012 (0.0791 - 0.0792)		Yellow		
4		2.012 - 2.015 (0.0792 - 0.0793)		Blue		
5		2.015 - 2.018 (0.0793 - 0.0794)		Pink		
6		2.018 - 2.021 (0.0794 - 0.0796)		Purple		
7		2.021 - 2.024 (0.0796 - 0.0797)		White		
01	UPP	2.003 - 2.006 (0.0789 - 0.0790)		19.9 - 20.1 (0.783 - 0.791)	Brown/Black	Grade is different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)				
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)			Green/Brown	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)				
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)			Yellow/Green	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)				
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)			Blue/Yellow	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)				
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink/Blue			
	LWR	2.012 - 2.015 (0.0792 - 0.0793)				
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple/Pink			
	LWR	2.015 - 2.018 (0.0793 - 0.0794)				
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White/Purple			
	LWR	2.018 - 2.021 (0.0794 - 0.0796)				

UNDERSIZE

NFEM0039S01
Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

SERVICE DATA AND SPECIFICATIONS (SDS)

Available Connecting Rod Bearing

Available Connecting Rod Bearing

NFEM0040

CONNECTING ROD BEARING

NFEM0040S01

Grade number	Thickness "T" mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

UNDERSIZE

NFEM0040S02
Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

Miscellaneous Components

NFEM0041
Unit: mm (in)

Flywheel runout [TIR]*	Less than 0.15 (0.0059)
Drive plate runout [TIR]*	Less than 0.15 (0.0059)

*: Total indicator reading

BEARING CLEARANCE

NFEM0041S01
Unit: mm (in)

Main bearing clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)*
	Limit	0.065 (0.0026)
Connecting rod bearing clearance	Standard	0.034 - 0.059 (0.0013 - 0.0023)*
	Limit	0.070 (0.0028)

*: Actual clearance